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Geology of Heenan and Marion Townships and the Northern Part of Genoa Township

District of Sudbury

By
A. M. GOODWIN

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COLOURED GEOLOGICAL MAP
(Back Pocket)

Map No. 2067—Heenan, Marion and Northern part of Genoa townships, District of Sudbury. Scale, 1 inch to ½ mile.

ABSTRACT

The map-area (Heenan, Marion, and northern Genoa townships), situated in the eastern part of the Swayze "greenstone" belt of northeastern Ontario, is underlain by assorted acid to basic volcanic rocks, banded iron formation, and younger granite and diorite. Volcanic rocks comprise an older group of predominantly acid pyroclastic rocks and a younger group of predominantly intermediate to basic lava flows with associated diorites. Iron formation is located at the contact of the two volcanic groups. The volcanic and associated rocks have been intruded by granite and still younger diorite. The rocks have been folded about steeply plunging axes: a west-facing anticline and a syncline cross the southern and northern parts, respectively, of Marion and Heenan townships. Numerous north- to northwest-trending transverse faults, generally with left-hand horizontal displacements, are present.

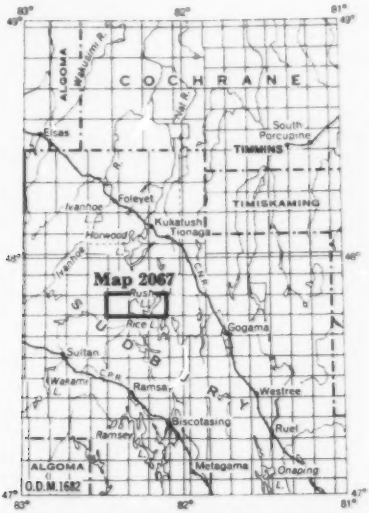

Figure 1—Key-map showing the location of Heenan, Marion, and Genoa townships. Scale, 1 inch to 50 miles.

The Woman River iron formation, of pronounced volcanic association, is highly variable in dimension and composition. A thick, continuous-banded, chert-jasper-siliceous magnetite zone, present to the southwest, grades northeastward to thin, discontinuous pyrite-siderite-chert zones. Iron content is generally highest at the stratigraphic base of the formation and decreases gradually upwards. Facies construction of the iron formation is attributed to a changing environment during the period of sedimentary deposition, which occupied a transitional pause in active volcanic discharge from older rhyolite to younger andesite.

The area has been investigated for iron, lead, zinc, and gold deposits, but there has been no ore production to date. Detailed drilling on iron bands to the east has indicated a limited tonnage of high-sulphur concentrating ore. Relatively small zones of siliceous magnetite are present at the base of the iron formation to the west. Some rich showings of lead-zinc mineralization present in iron formation to the east have failed to show necessary continuity at depth. Gold values are present in several small porphyry stocks. Continued exploration in the area and changing market demands may eventually lead to the development of an ore deposit.

Geology of Heenan and Marion Townships, and the Northern Part of Genoa Township

By

A. M. Goodwin[1]

Introduction

The Woman River iron range extends across Genoa, Marion, and Heenan townships in the eastern part of the Swayze "greenstone" belt in the District of Sudbury. The iron formation has a pronounced volcanic association since it is situated at the contact between underlying acid pyroclastic rocks and overlying andesitic volcanic flows; it is highly variable in dimension and composition, ranging from a thick, continuous-banded, jasper-siliceous magnetite zone in the west to several thin, discontinuous, pyrite-siderite-chert zones in the east. The iron formation and adjoining rocks have been explored at various times by means of trenching, diamond-drilling, and limited underground work, in search of iron, base metal, and gold deposits. Iron deposits of significant size have been outlined; lead-zinc mineralization associated with banded iron formation has been located; and some small gold prospects have been drilled. Despite this activity, there has been no ore production from the area to date.

Access

The area is readily accessible by aircraft from either Gogama, 30 miles east on the Canadian National railway, or from Chapleau, 50 miles west on the Canadian Pacific railway. Canoe routes are available via Opeepeesway River and Woman River on the south, Horwood Lake on the north, and from Stackpool, 30 miles east on the Canadian National railway. The nearest road extends for 60 miles from Chapleau to the old Jerome mine situated 12 miles south of the map-area.

Previous Work

The map-area forms a part of a larger area mapped by H. M. Bannerman (1934). The Woman River iron range is described in reports by R. C. Allen (1909) and E. S. Moore (1927). Adjoining areas to the south are described in reports by H. C. Laird (1936), W. W. Moorhouse (1951), and Emmons and Thomson (1929); to the west by G. D. Furse (1932) and H. C. Rickaby (1935); and to the north by E. W. Todd (1925) and W. D. Harding (1938).

Topography

The map-area is comparatively low and flat, except for occasional ridges and hills underlain mainly by iron formation, which have maximum local relief of 280 feet. Numerous swamps are present, particularly in southern Marion and northern Heenan townships. Rush Lake on the east is the principal body of water in the area; Gowagamak, Trailbreaker, Heenan, and October lakes are

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Landscape view of map area looking northeast towards Claim Lake from iron ridge in claim W.S. 8, Heenan township.

Forest, stream, and outcrops, Woman River, Marion township.

sizeable lakes in the northern and western parts of Heenan township; in addition to these lakes, certain stretches of Woman and Rush rivers can be used for landing light aircraft.

The area is drained northward to Horwood Lake by the Woman River and its tributaries: Opeepeesway River on the south; Heenan Creek on the west; and Rush River, which drains Rush Lake, on the east.

Because most rock ridges are veneered with moss and shrubs, outcrops generally require stripping; as a result, individual rock features cannot confidently be extended beyond the immediate point of observation.

Field Methods

Field mapping was conducted at a scale of 1 inch to ¼ mile, using vertical air photographs, and cronaflex basemaps prepared by the Cartographic Unit of the Ontario Department of Mines. A baseline, 11 miles long, cut and surveyed under the supervision of the Mining Lands Branch, Ontario Department of Mines, provided essential control for detailed traversing over the iron formation. That portion of Genoa township within the map-area, most of Marion township (the small portion north of Woman River in the northwest corner excepted), and the southeast quarter of Heenan township—together embracing the iron range and adjacent rocks—were mapped by the author during the 1961 field season. The remainder of Heenan and Marion townships was mapped by J. F. Donovan and party during the 1962 field season, in conjunction with additional mapping to the west.

Uncoloured preliminary geological maps (P. 135, Heenan township; P. 136, Marion township; P. 137, Genoa township) covering the 1961 field work were published by the Ontario Department of Mines on the scale of 1 inch to ¼ mile.

Acknowledgments

Grateful acknowledgment is made for the valuable co-operation of Stackpool Mining Company Limited and Algoma Ore Properties Division of The Algoma Steel Corporation Limited, in providing geological and diamond-drilling data from their private files. Thanks are due to Ontario Department of Lands and Forests personnel at Gogama and Chapleau for supplying and maintaining contact with the field parties. Thanks and appreciation are due to J. F. Donovan, V. H. Becker, J. K. Potts, and R. H. Ridler, the author's assistants during the 1961 field season. Mr. Donovan, as senior assistant, conducted independent mapping in the 1961 season and completed mapping the western part of the area in the 1962 season as outlined above.

All chemical analyses and photomicrographs were made in the Laboratory Branch, Ontario Department of Mines, Toronto. Magnetic concentration tests were made in the laboratories of the Ontario Research Foundation in co-operation with the Laboratory Branch, Ontario Department of Mines, Toronto.

General Geology

The bedrock of the area, of Precambrian age, comprises an older assemblage of acid to basic volcanic rocks and banded iron formation, and younger granitic, dioritic, and diabasic intrusions. These rocks, now folded, faulted, and eroded, have been veneered to different degrees with Pleistocene and Recent debris and alluvium.

Figure 2—TABLE OF FORMATIONS

CENOZOIC

PLEISTOCENE AND RECENT: Sand, till, peat, muck, stream deposits.

Great Unconformity

PRECAMBRIAN

LATE DIABASE INTRUSIONS: Quartz diabase; olivine diabase.

Intrusive Contact

DIORITIC INTRUSIONS: Massive diorite; quartz diorite; feldspar porphyry; lamprophyre.

Intrusive Contact

ACID INTRUSIONS: Massive granite; porphyritic granite; granodiorite; syenite; aplite.

Intrusive Contact

VOLCANIC-SEDIMENTARY ASSEMBLAGE

Intermediate to Basic Volcanic Rocks:

Andesite and basalt lavas, including pillow flows; amygdaloidal lavas; fragmental lavas; diorite and gabbro; sheared volcanic rocks.

Woman River Iron Formation:

Banded chert with one or more of magnetite, hematite, siderite, pyrite and pyrrhotite; carbonaceous chert.

Acid to Intermediate Volcanic Rocks:

Rhyolite, dacite, and trachyte breccia, tuff, and agglomerate; andesite lavas; sheared volcanic rocks.

The older assemblage of volcanic and sedimentary rocks comprises: a lower volcanic association of acid to intermediate extrusive rocks; the conformably overlying Woman River iron formation; and an upper volcanic association of predominantly intermediate to basic flows and pyroclastic rocks.

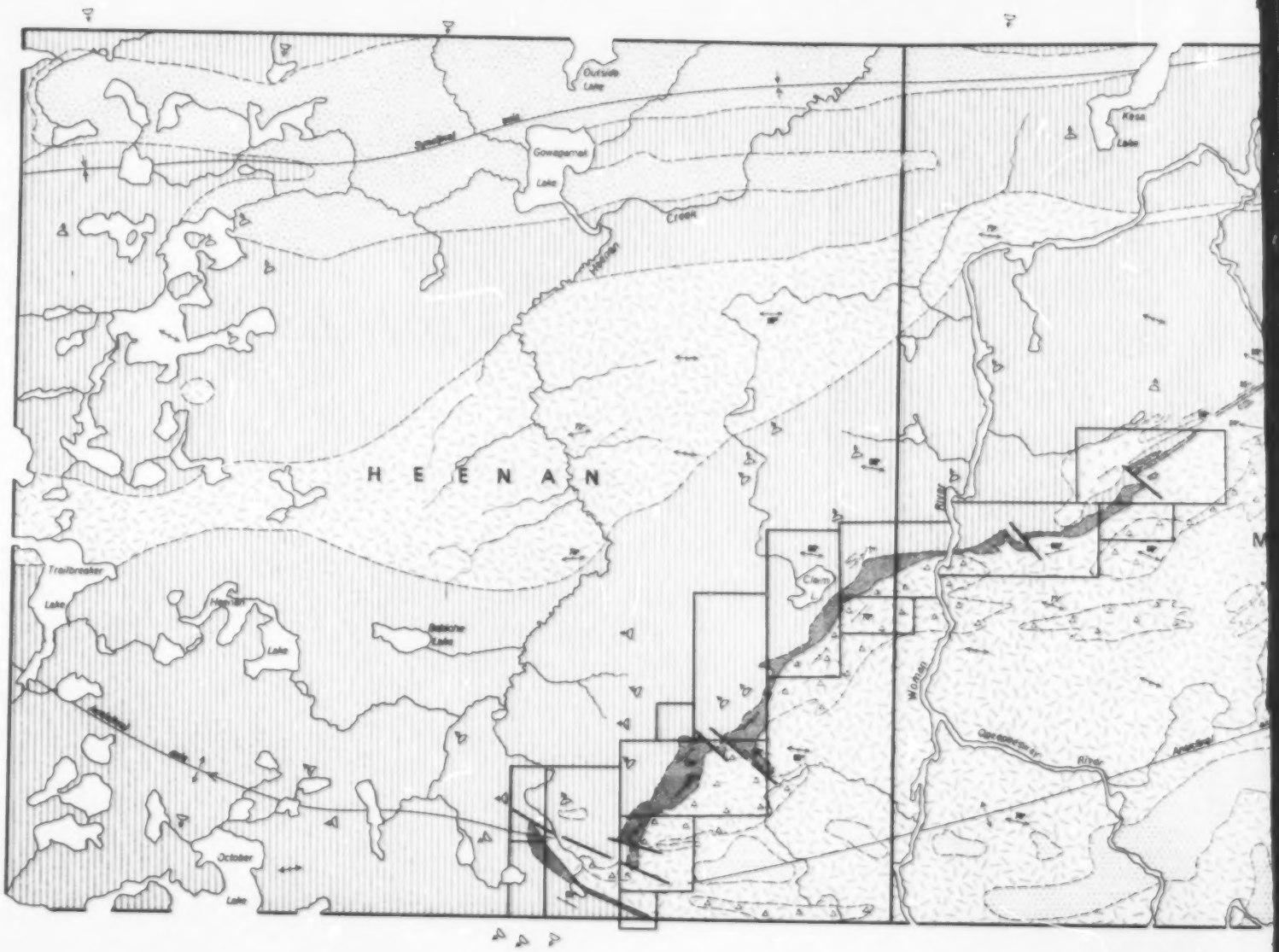
The older volcanic and sedimentary rocks have been intruded by acid to basic igneous rocks. Acid igneous rocks, largely granite but including granodiorite and syenite, form large regional masses that extend for many miles to the east, as well as small stocks enclosed in the volcanic rocks. Diorite and gabbro dikes, sills, and irregular masses have intruded both the granitic rocks and the older volcanic rocks. Numerous diabase dikes transect all other rocks of the map-area.

VOLCANIC-SEDIMENTARY ASSEMBLAGE

Acid to Intermediate Volcanic Rocks

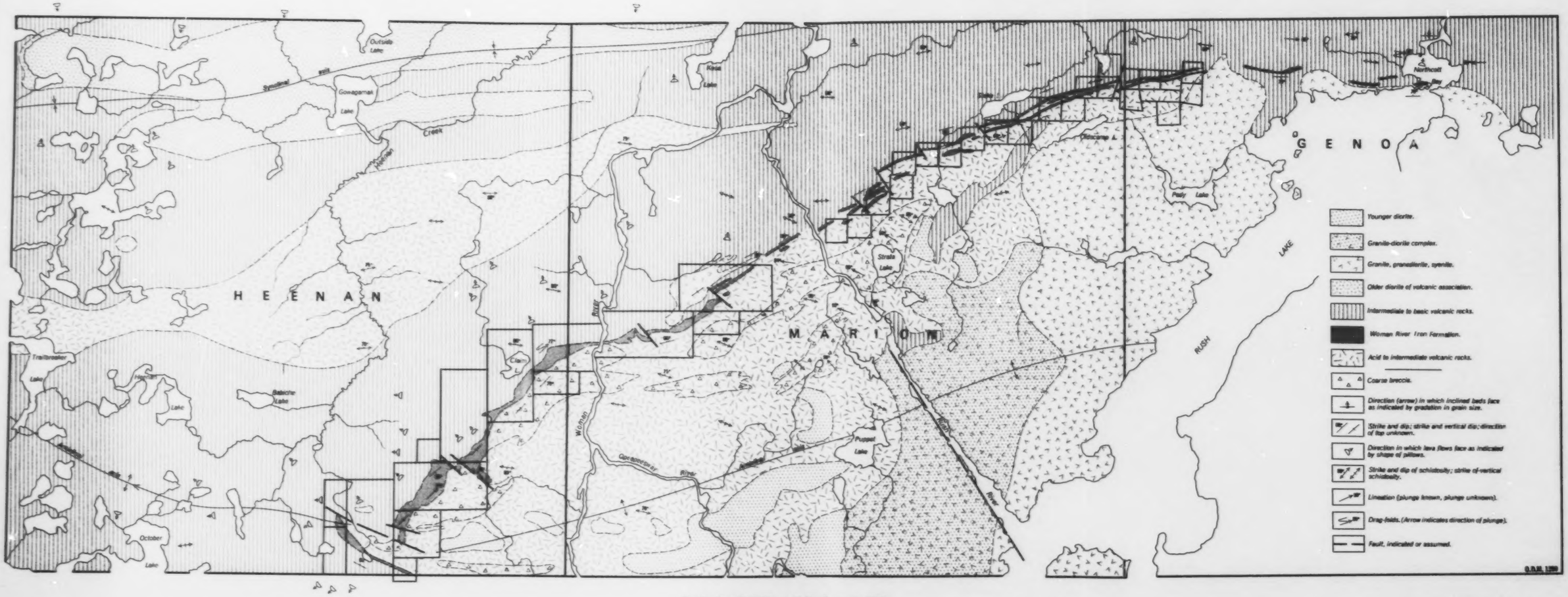
DISTRIBUTION AND LITHOLOGY

Acid to intermediate volcanic rocks form a prominent, wedge-shaped belt about 10 miles long and up to 3 miles wide; the thin edge of this belt projects northeast into Genoa township, thickening, southwestward across Marion township, to the southeast corner of Heenan township. The rocks of this belt are bordered on the southeast by younger intrusive granite and diorite, and on the northwest by the Woman River iron formation and overlying volcanic rocks. A maximum stratigraphic thickness of 10,000 feet of acid to intermediate volcanic



Scale 1 : 63,360 or 1

Figure 3 – Sketch map showing general geology of Heenan, Marion



Scale 1 : 63,360 or 1 Inch to 1 Mile

Chains 80 40 0 1 2 3 4 5 Miles

Figure 3 — Sketch map showing general geology of Heenan, Marion Townships, and part of Genoa Township, District of Sudbury.

rocks is estimated to be present in the belt, due allowance being made for present structural distribution.

Volcanic rocks of this belt vary considerably in composition and structure. Rhyolite, dacite, and trachyte pyroclastic rocks and flows commonly alternate frequently. Of these, rhyolite is the dominant component. Andesite flow and tuff intercalations are present; they are generally less than 60 feet thick, but locally, as for example in the Strata Lake–Oldscamp Lake area, they form persistent zones ranging up to several hundred feet thick and several miles long.

Photomicrograph of fine-grained tuff, illustrating shardlike character of recrystallized material, Heenan township.

In addition to their respective distribution as relatively pure units within a complex pile, specific volcanic types are commonly intermingled within individual pyroclastic units in the form of mixed tuffs and breccias. In such instances, the fragments are generally of more acid composition than the matrix; in places the situation is reversed, the fragments being of more basic composition; in rare instances, both acid and basic fragments are commingled in a uniformly basic matrix. In this manner, volcanic flows, tuffs, and breccias display great heterogeneity, seeming to represent products of a varied and complex effusive history.

Considering the acid volcanic rocks in general, relatively fine-grained extrusive phases are common in the lower stratigraphic portions and towards the northeast margin of the belt, specifically in the Opeepeesway River–Puppet Lake vicinity and near Oldscamp Lake. In contrast, the upper stratigraphic portions of the belt, adjacent to the overlying banded iron formation, contain a high

proportion of relatively coarse-grained volcanic tuff and breccia (Fig. 3). This division of the acid volcanic belt into lower massive and upper fragmental phases, though somewhat arbitrary, reflects its general volcanic history: gentle expulsion of fine-grained tuffs and flows was succeeded by highly explosive, forceful expulsion of relatively coarse-grained pyroclastic material.

Finer-grained phases of the acid volcanic rocks range from white to grey to greyish green in colour, and from dense to banded and porphyritic in texture. Much of the rock appears to represent individual ash fall accumulations. Greyish green, streaky felsite exposed on the west bank of Northcott Bay, Rush Lake, is composed of fine-grained quartz-feldspar-sericite mosaics with thin, irregular laminae rich in fine-grained chlorite-zoisite aggregates. Pale-grey, massive to slightly sheared, rhyolite porphyry, common throughout the belt, contains both quartz and feldspar phenocrysts, up to ¼ inch in diameter, in a dense quartz-feldspar-sericite-chlorite matrix; in sheared and altered equivalents, feldspar phenocrysts, variously altered to fine-grained sericite-carbonate-feldspar alteration clusters, contrast with large, strained, partly fragmented quartz phenocrysts. Silvery grey schist with pronounced linear, or "pencil," structure exposed near Rush River is composed of dense, quartz-feldspar-sericite-chlorite-carbonate aggregates enclosing occasional large zoisite-epidote clusters.

In the distinctly fragmental, or breccia phases, visible fragments in hand specimens range from barely perceptible rock chips up to angular blocks as much as 24 inches in diameter. In general, breccia fragments increase in abundance, size, and acidity towards the top of the pile. Concentrations of larger fragments, presumably reflecting proximity to source vents or fissures, are located near Strata Lake, Marion township, and in claims W.S.4–9, Heenan township (Fig. 3). Breccia fragments are characteristically angular to subrounded, thereby demonstrating negligible to limited abrasion during transportation. The proportion of fragments to matrix ranges from sparse to crowded. The breccia deposits are generally completely unsorted, typically comprising chaotic jumbles of angular lithic fragments apparently derived largely by explosive shattering of pre-existing rock units. Occasional breccia units contain a high proportion of rounded, amygdaloidal fragments possibly derived by direct expulsion of fluid or partly congealed lava.

No direct evidence of specific centres of accumulation, such as volcanic cones, was observed in the volcanic pile. Although such evidence may have been overlooked, or obscured by post-volcanic erosion and alteration, volcanic discharge and accumulation may well have proceeded by way of fissures relatively widely spaced. Certain massive, porphyritic zones associated with the acid breccia may represent volcanic vents. The following descriptions serve to indicate the variety and general nature of acid breccia in the area.

Acid volcanic breccia north of Oldscamp Lake near the northeast end of the iron range contains abundant, small, white, lenticular rhyolite fragments up to 1 by 4 inches in size in a dense to schistose, sericite-quartz-feldspar matrix. The ratio of fragments to matrix is generally about 1:1.

Volcanic breccia exposed on the northeast shore of Strata Lake, ½ mile east of Rush River, Marion township, is composed of pinkish grey, angular, lithic fragments in a sparse, grey-green, dacitic matrix. A salient feature of this deposit is the complete absence of sorting or stratification; adjacent fragments, up to angular cobbles 14 inches in diameter, are in chaotic disarray, thereby suggesting an avalanche, or mud-flow, type of accumulation. In thin section,

the fragments are seen to contain abundant, lath-like, albite feldspar phenocrysts in a fine-grained, feldspar-sericite-chlorite-quartz matrix.

A considerable variety of breccia is exposed near Rush River and south of the banded iron formation. For example, a mile east of the river, in claim W.D.1733, volcanic breccia contains many 6- to 8-inch long, pale-grey, felsite fragments in a predominantly sericitic matrix. Ten chains east of Rush River, along strike of the zone described above, poorly sorted, angular, pinkish grey, trachytic fragments up to 4 inches in diameter are distributed in a 30-percent predominantly chloritic matrix. Immediately west of Rush River, fine- to

Rhyolite breccia, southeast of Claim Lake, Heenan township.

medium-grained, acid breccia, underlying low ridges that locally rise above the sand flats, contains abundant, small, angular, white rhyolite fragments 1–4 inches in diameter in a sparse, grey-green chloritic matrix.

Midway between Rush River and Woman River, in claim W.S.2, Marion township, and immediately to the south, volcanic breccia composed of markedly angular, pink felsitic fragments, mainly 2–3 inches long but up to 12 inches long, in a sparse, dark-green, chloritic matrix, is interzoned with fine-grained rhyolite breccia crammed with small (less than 1 inch diameter), angular, white rhyolite fragments in a sparse sericitic matrix. This interzoning of contrasting lithologic types apparently reflects compositional fluctuations in discharge from the same volcanic vent, or else from closely spaced ones.

A section of volcanic breccia roughly 2,200 feet thick, intermittently exposed on the banks of Woman River south of the iron formation, contains roughly equal proportions of (1) fine-grained, rhyolite breccia composed of small, angular

fragments of massive, grey rhyolite up to 4 inches long in a sparse sericite-chlorite matrix, interzoned with (2) relatively coarse-grained agglomerate composed of angular to subrounded fragments of grey-green, quartz porphyry up to 20 inches in diameter set in a sparse, chloritic, quartz-charged matrix. In the eastern extension of this zone, in claim W.S.3, volcanic breccia contains a few fragments of dark-green andesitic lava associated with predominant rhyolite fragments; this represents one of the few such hybrid breccias observed in the area.

Rhyolite breccia, northeast shore of Strata Lake, Marion township.

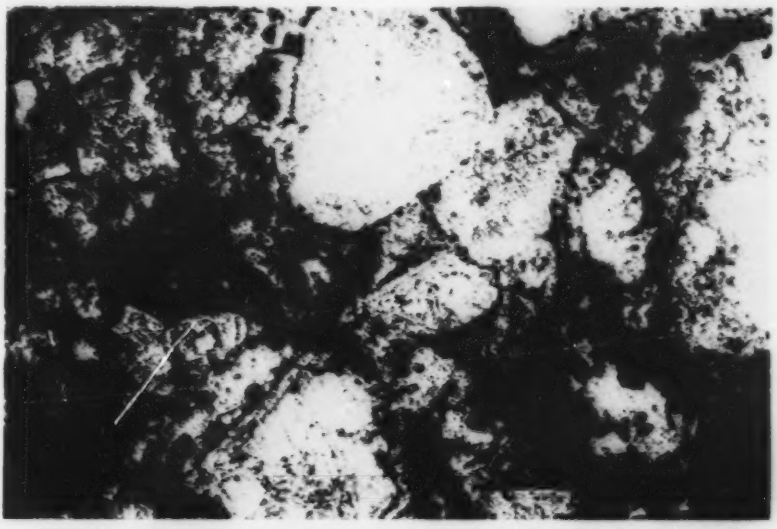
West of Woman River, in Heenan township, acid breccia is widespread and prominently exposed on the hills and ridges southeast of the iron formation. Fine-grained breccia, ¼ mile west of Woman River and ¾ mile south of the iron formation, is composed of abundant, tiny, lenticular, grey and pink felsitic fragments, generally less than ¼ inch long, in a dense felsitic matrix. This type of breccia is underlain to the south by white breccia composed of angular rhyolite fragments 2–4 inches in diameter, in a dense matrix of the same composition.

An unusual type of breccia in the west half of claim W.S.5 and the southeast quarter of claim W.S.4 contains fragments composed of individual, euhedral to subhedral, whitish feldspar crystals, portions of feldspar crystals, or clusters of crystals, generally ½–1 inch long but up to 3 inches long, in a dense sericitic matrix. In thin section, the feldspar crystals are seen to be composed of secondary albitic feldspar aggregates with associated quartz and sericite. (*See* photo p. 9, lower). This particular breccia appears to have formed by volcanic expulsion and accumulation of complete or fragmented feldspar crystals possibly of magmatic or intertelluric derivation.

Acid porphyry breccia. Fragments include feldspar crystals as at point of knife (5 inches long); in claim W.S. 5, Heenan township.

Photomicrograph of porphyry breccia, illustrating presence of euhedral to subhedral feldspar fragments. Feldspar almost entirely altered; unaltered remnants (smooth grey) suggest original albite-oligoclase in claim W.S. 5, Heenan township. (X 56)

In claim W.S.4, coarse volcanic breccia, exposed 300 feet south of the iron formation, contains angular fragments of massive to porphyritic rhyolite up to 26 inches long in a sparse chloritic matrix. Immediately east of the southeast quarter of claim W.S.8, Heenan township, a group of relatively high mounds are underlain by compact, firmly welded breccia, in which individual feldspar porphyry fragments, up to 3 inches in diameter, are discernible with difficulty from a sparse matrix of similar composition. The fragments are surrounded locally by trains of arcuate grains of magnetite and pyrite associated with chlorite. (*See* photo below). These features suggest the presence of vent agglomerate possibly affected by contemporaneous fumarolic activity.

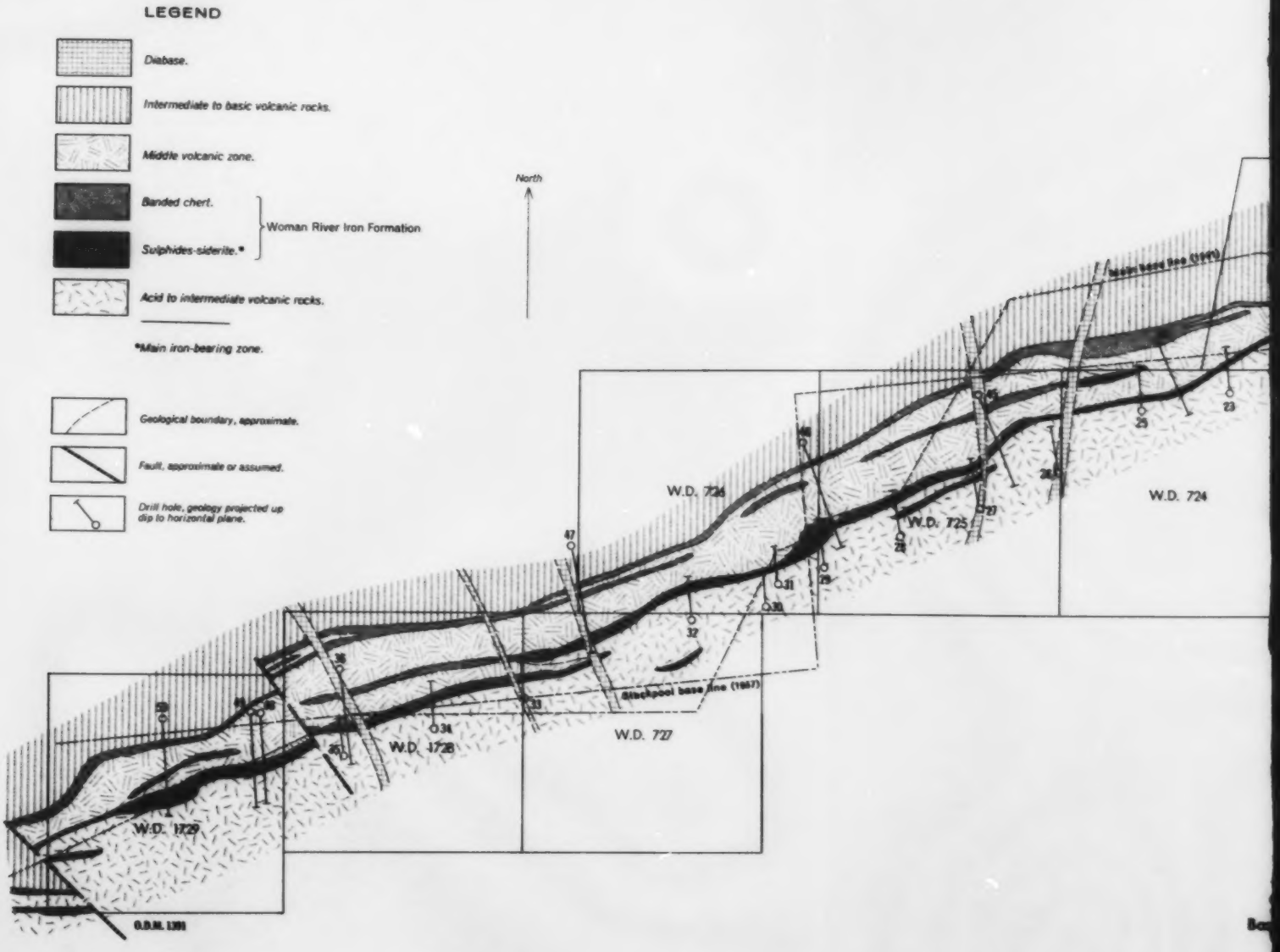


Photomicrograph of rhyolite breccia illustrating nature of rock fragments and presence of inter-fragmental pyrite, in Heenan township. (X 56)

ALTERATION

West of Rush River the acid to intermediate volcanic rocks show little sign of alteration, massive and fragmental phases alike being for the most part remarkably fresh and unaltered. Locally, however, the topmost 4–5 feet adjacent to overlying iron formation is sparsely impregnated with magnetite and (or) pyrite, thereby suggesting limited passage through the rocks of iron-bearing solutions or gases of possible fumarolic derivation.

Northeast of Rush River, however, where siderite and pyrite are important constituents of the iron formation, the footwall acid pyroclastic rocks have been chemically altered down to stratigraphic depths of 50–200 feet. Within this chemically altered zone both the matrix to the volcanic fragments and also the rims of the fragments themselves have been chloritized, carbonatized, and locally pyritized. The effect has been to round-out original angular, lithic fragments and so produce pseudo-conglomerate. Study of alteration sequences within the altered zone, however, leaves little room for doubt that present frag-


LEGEND
Diabase.
Intermediate to basic volcanic rocks.
Middle volcanic zone.
Banded chert.
Sulphides-siderite.*
Woman River Iron Formation
Acid to intermediate volcanic rocks.
*Main iron-bearing zone.
Geological boundary, approximate.
Fault, approximate or assumed.
Drill hole, geology projected up dip to horizontal plane.
North
W.D. 726
W.D. 725
W.D. 724
W.D. 727
W.D. 1728
W.D. 1729
Stockpool base line (1967)
O.D.N. 1391

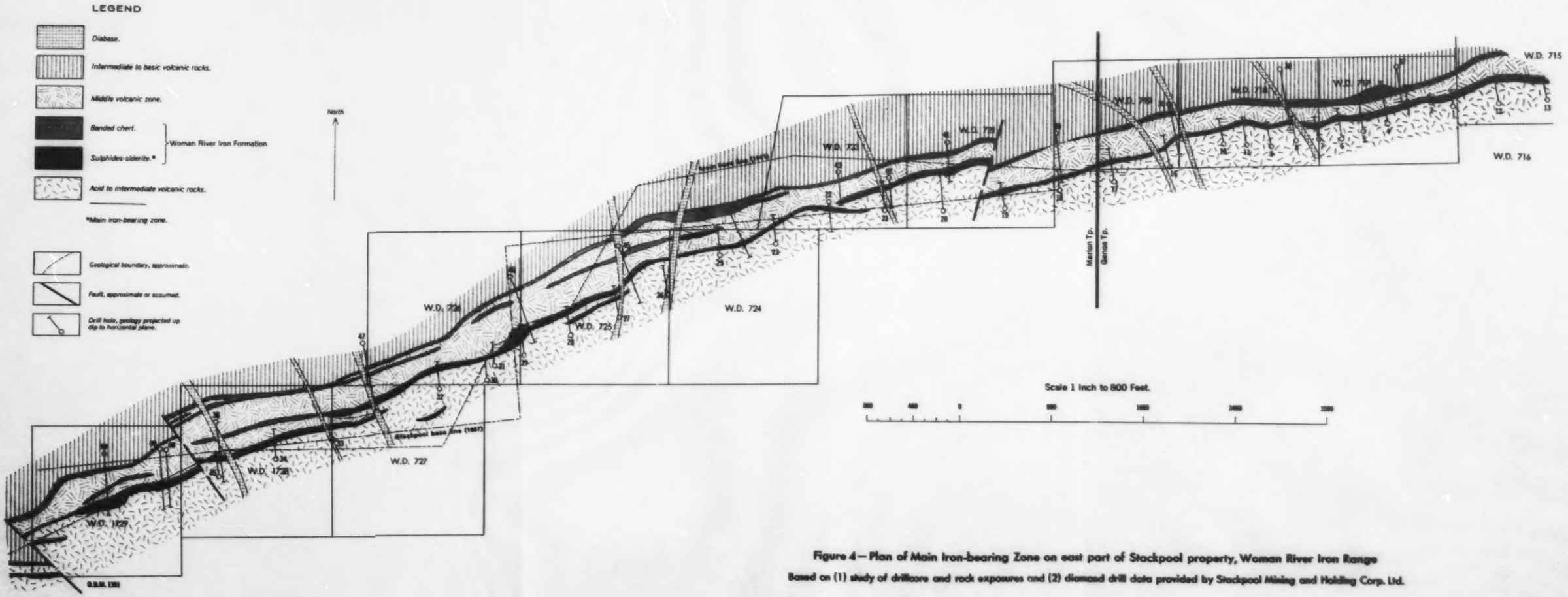


Figure 4—Plan of Main Iron-bearing Zone on east part of Stockpool property, Woman River Iron Range

Based on (1) study of drillcore and rock exposures and (2) diamond drill data provided by Stockpool Mining and Holding Corp. Ltd.

ment roundness is a secondary effect due to marginal replacement *in situ* rather than mechanical erosion during fragment accumulation.

The general nature of the chemical alteration of footwall volcanic rocks to the northeast is illustrated by the lithologic relation in Drillhole No. 33, (*see* Fig. 4). Footages cited refer to stratigraphic depths below iron formation: at 100 feet, minute blebs of sideritic carbonate, representing incipient chemical alteration, are present in rhyolite tuff-breccia; at 75 feet, white, angular lithic fragments are thinly but noticeably rimmed with green chlorite-carbonate haloes; at 50 feet the tuff-breccia contains 30–50 percent siderite, chlorite, and disseminated pyrite present both in the matrix and as marginal replacements of lithic fragments; and finally, within 10 feet, the wallrock contains equal parts of whitish, round to subrounded, marginally altered, lithic fragments and fine-grained, pyritiferous, chlorite-siderite matrix.

In Genoa township and the adjoining part of Marion township, later thermal metamorphic effects have been superimposed upon the chemically altered rocks. This has resulted in local development of secondary silicates such as garnet, amphibole, and staurolite, particularly where the earlier chemical alteration had been severe. Thermal metamorphism may be reasonably ascribed to intrusive effects of nearby granite.

The chemical compositions of typical footwall volcanic rocks south of the main iron-bearing zone on the Stackpool property, Genoa and Marion townships (Fig. 4), are shown in Table I (Samples Nos. 1–6). Altered volcanic rocks ranging in composition from rhyolite to andesite are represented. The rocks are now largely composed of fine-grained aggregates of secondary minerals as listed in the table. Some analyses reveal the effects of earlier chemical alteration alone (*e.g.* Table I, Samples Nos. 1–3, 6), whereas others reveal, in addition, the later metamorphic effects (*e.g.* Table I, Sample No. 5). Compared to average volcanic rocks throughout the world (Table I, Samples Nos. 15–18), the footwall rocks in Genoa and Marion townships show an apparent enrichment in FeO, CO_2, MgO, and H_2O, and an apparent loss in SiO_2 and alkalies.

Woman River Iron Formation

The Woman River Iron Formation is the rock unit composed predominantly of interbanded chert and one or more iron-bearing minerals that lies at the stratigraphic contact between underlying predominantly acid volcanic rocks and overlying predominantly intermediate to basic volcanic rocks in Genoa, Marion, and Heenan townships. To the southwest, in Heenan township and the adjacent part of Marion township, a single, continuous band composed mainly of banded chert, jasper, and siliceous magnetite is present. The transitional equivalent to the northeast, in Marion and Genoa townships, comprises several thin, discontinuous bands composed mainly of chert, siderite, and pyrite together with their alteration products (Fig. 3). Where two or more parallel bands are present, the upper stratigraphic band(s) is predominantly cherty, whereas the lowermost stratigraphic band commonly contains carbonate and sulphide minerals and their alteration products. In this manner, on the east property of Stackpool Mining Company Limited, in Marion and Genoa townships, of the several parallel bands present, the lowermost, or south, band constitutes the main iron-bearing zone. This zone is separated from one or more parallel, predominantly cherty bands to the north by an association of acid to basic volcanic rocks referred to as the middle volcanic zone (*see* Fig. 4).

TABLE I—CHEMICAL ANALYSES OF VOLCANIC ROCKS, MARION AND GENOA TOWNSHIPS

Analysis No.	61-5-2	61-5-7	61-5-12	61-5-31	61-5-27	61-5-49	61-5-13	61-5-22	61-5-19	61-5-48	61-5-40	61-5-36	61-5-16	61-5-80
Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SiO_2	53.78	54.01	54.02	75.20	46.54	56.98	52.96	64.53	46.80	69.78	63.01	49.03	53.58	52.29
Al_2O_3	18.18	7.98	11.48	15.80	19.11	12.24	17.04	18.46	16.75	15.55	16.14	16.25	17.98	17.39
Fe_2O_3	0.90	5.60	2.42	nil	2.42	0.94	0.17	nil	2.29	0.67	1.03	2.02	0.26	1.61
FeO	5.92	11.75	8.64	0.70	9.07	12.29	9.58	6.60	16.93	2.78	3.59	9.20	11.11	7.81
CaO	7.73	5.51	4.77	2.84	9.92	3.97	6.90	3.22	5.82	1.88	4.89	8.91	5.41	6.64
MgO	2.13	3.15	2.67	0.91	5.79	6.24	3.04	2.66	4.55	1.97	3.31	3.55	3.61	4.28
Na_2O	2.76	0.18	0.36	1.13	1.19	0.13	0.55	0.31	0.63	1.81	2.48	1.68	1.39	3.08
K_2O	0.77	0.88	1.38	1.72	0.54	0.39	1.36	1.05	0.33	1.79	1.27	0.78	0.75	0.12
H_2O+	2.74	3.17	2.14	1.07	2.42	3.64	2.85	2.27	3.40	1.88	1.82	2.46	2.60	3.77
H_2O-	nil	0.02	nil	nil	nil	0.06	nil	0.02	0.05	0.11	0.07	0.01	0.04	0.09
TiO_2	0.82	0.33	0.24	0.27	0.86	0.22	0.30	0.47	1.96	0.27	0.46	1.00	1.23	0.75
P_2O_5	nil	nil	0.28	0.25	0.19	0.22	0.28	0.25	0.28	0.20	0.14	0.17	0.28	0.28
MnO	0.14	0.46	0.47	0.03	0.32	0.52	0.25	0.15	0.31	0.07	0.15	0.23	0.33	0.26
CO_2	3.32	6.74	7.69	0.09	0.77	2.92	4.71	0.22	nil	0.82	1.50	4.07	1.31	1.65
Cr_2O_3	trace	trace	trace	trace	0.06	trace	trace	trace	0.01	trace	trace	0.07	trace	0.08
V_2O_3	0.04	trace	trace	trace	0.04	trace	trace	0.01	0.06	trace	0.01	0.03	0.04	0.03
FeS_2	—	—	2.84	—	—	—	—	—	—	—	—	—	—	—
Total	99.23	99.78	99.42	100.07	99.24	100.76	99.99	100.22	100.17	99.59	99.87	99.41	99.92	100.13
Specific Gravity	2.86	2.76	2.75	2.74	3.08	2.95	2.68	2.83	3.16	2.72	2.71	2.84	2.97	2.70

Sample No.	Location[1]	Rock Classification[2]	Lithology
1	Hole No. 32; 30–50 ft.	Andesite	Altered. Zoisite-epidote-chlorite-plagioclase-quartz-leucoxene-carbonate.
2	Hole No. 32; 130–150 ft.	Rhyolite-dacite	Highly altered. Zoisite-chlorite-feldspar-quartz-siderite-white mica.
3	Hole No. 32; 230–250 ft.	Rhyolite	Altered. Chlorite-feldspar-quartz-siderite-white mica-zoisite.
4	Hole No. 39; 595–615 ft.	Rhyolite-dacite	Altered. Feldspar-quartz-white mica-garnet.
5	Hole No. 32; 522.5–542.5 ft.	Andesite-basalt	Altered. Amphibole-zoisite-feldspar-quartz-calcite-chlorite.
6	Hole No. 44; 675–725 ft.	Rhyolite	Altered. Chlorite-feldspar-quartz-carbonate-garnet.
7	Hole No. 32; 383–398 ft.	Andesite	Altered. Chlorite-feldspar-quartz-carbonate-chloritoid.
8	Hole No. 39; 352–402 ft.	Dacite	Altered. Quartz-feldspar-white mica-chlorite-staurolite.
9	Hole No. 39; 225–241 ft.	Andesite-basalt	Altered. Amphibole-zoisite-feldspar-quartz-ilmenite (leucoxene)-garnet.
10	Hole No. 44; 575–594 ft.	Rhyodacite	Altered. Feldspar-quartz-white mica-leucoxene-carbonate-pyrite.
11	Hole No. 44; 225–275 ft.	Dacite	Altered. Feldspar-white mica-quartz-chlorite-carbonate.
12	Hole No. 44; 25–75 ft.	Andesite-basalt	Altered. Chlorite-zoisite-feldspar-quartz-carbonate-magnetite.
13	Hole No. 39; 50–100 ft.	Andesite	Altered. Chlorite-zoisite-feldspar-quartz-carbonate-black oxide.
14	Surface sample pillow lava; Main Falls, Woman R.	Andesite	Altered. Zoisite-chlorite-feldspar-quartz-carbonate-black oxide.

Analyses by Laboratory Branch of the Ontario Department of Mines, 1962.

[1]Samples 1–6 from volcanic rocks underlying the iron formation.
Samples 7–12 from volcanic rocks lying between bands of iron formation.
Samples 13, 14 from volcanic rocks overlying the iron formation.
All drillhole samples composed of closely-spaced chips taken over the specified drill interval.

[2]Original rock composition, prior to chemical alteration, as estimated by author.

DISTRIBUTION AND THICKNESS

Banded iron formation extends along strike for 14 miles from Northcott Bay, Genoa township on the east, to the southeast quarter of Heenan township on the west (Fig. 3). The iron formation, now folded close to the vertical, trends east-west within Genoa township, thence southwest for 9 miles to claim W.S.9, Heenan township. This change in strike traces out a west-facing anticlinal structure as described on page 32. With the exception of small lenses in Benton and Mallard townships to the south, the Woman River Iron Formation as now known lies entirely within the map-area.

In this report the Woman River Iron Formation is divided into four geographic sections, as follows: (1) Northcott Bay section—from Northcott Bay west for 2.5 miles to claim W.D.715, Genoa township; (2) Stake Lake section—from claim W.D.715, Genoa township, west for 4.5 miles to Rush River; (3) Rush River–Woman River section—for 2.6 miles between the two rivers; and (4) Heenan section—west of Woman River. The iron formation has been delineated by means of detailed traversing off the Main Base Line (1961) (Fig. 4) in Marion and Heenan township, and off the Stackpool Base Line (1957) (Fig. 4) in Genoa township, supplemented and extended where available by diamond-drill data in claims W.D.719–721 inclusive, Genoa township.

Northcott Bay Section

The most easterly exposure of iron formation in the map-area, situated at the southwest entrance to Northcott Bay, is 15–20 feet thick and can be traced 200–300 feet along strike to the west. Bands of iron formation of similar dimensions are intermittently exposed for 1.5 miles to the west; at this point a lenticular band up to 200 feet thick extends 3,000–4,000 feet west, where it either lenses out or abuts against a northward-projecting tongue of granite immediately east of claim W.D.715, Genoa township.

Stake Lake Section

West of this granite tongue, iron formation is of more continuous distribution, several parallel bands generally being present. Individual bands have a lenticular and irregular habit, which makes their stratigraphic continuity uncertain; they are commonly 10–40 feet thick and a few thousand feet long, but are up to 120 feet thick over a length of 6,000–10,000 feet.

The distribution and character of the iron formation in the Stake Lake section is best known in the northeastern part, specifically in claims W.D.715–728 inclusive and W.D.1729, on the basis of recent detailed diamond-drilling by Stackpool Mining Company Limited. The core from about 50 diamond-drillholes was relogged by the author and his party during the field season. This information, together with regular outcrop data, forms the basis for Figure 4.

In detail, as illustrated in Figure 4, a southerly band, 10–40 feet thick, extends 5,000 feet along strike from a point 400 feet east of claim W.D.715, across claims W.D.715–720, to the east side of claim W.D.721. A second parallel band, 10–100 feet thick, lies 100–200 feet north. West of claim W.D.721, two parallel bands, apparently the faulted extension of those described above, extend across claims W.D.721–728 inclusive; the south band is generally 10–20 feet thick, whereas the north band is up to 100 feet thick. A third parallel band of iron formation, thin and discontinuous in habit, is also present in claims W.D.725 and

728. Southwestward from this point to Rush River, the iron formation bands are relatively thin and discontinuous. Two parallel bands, each less than 50 feet thick, extend across claims W.D.1729–1732. In claim W.D.1734 an iron formation band, about 100 feet thick and at least 1,000 feet long, extends diagonally across the claim from northeast to southwest; a second thin band lies parallel to it a few hundred feet north. Finally, in claims W.D.1735 and 1736 and immediately to the north, two parallel bands, each 10–20 feet thick and 500–700 feet apart, extend to the vicinity of Rush River.

Rush River–Woman River Section

Very thin, discontinuous bands of iron formation extend from Rush River on the east to the centre of claim W.S.1, midway between Rush and Woman rivers. A typical north-south section situated 2,000 feet west of the Rush River contains three separate iron bands, each 2–10 feet thick and 50–300 feet apart. West of this point, a single, continuous iron band that extends westward across claims W.S.2 and 3, Marion township, is 50–300 feet thick.

Heenan Section

West of Woman River to the Marion-Heenan townships boundary, the iron formation band is drift-covered; however, its presence is indicated by a pronounced magnetic deflection. From the west half of claim W.S.6, Heenan township, southeastward for 2.7 miles to claim W.S.9, Heenan township, an iron formation band underlies a broad ridge of prominent relief and rock exposure. In claim W.S.6, at the northeast end of the ridge, the iron formation band is 725 feet thick; it narrows gradually to 400 feet at the southwest corner of the claim, thickening in turn to 600 feet in the east half of W.S.4, the adjacent claim to the west. At the centre of this claim the band pinches abruptly to 100 feet, then thickens westward again to 600 feet at the west boundary of the claim; at this point the band once more abruptly pinches to less than 120 feet, gradually thickening again to a maximum of 800 feet in claim W.S.7. A long narrow projection of iron formation, the product of folding and faulting, is present in the northeast quarter of claim W.S.8. A maximum thickness for the Woman River iron formation of 1,400 feet is attained in the centre of claim W.S.8, whence the band gradually thins southwestward to 600 feet in the north half of claim W.S.9. Scattered outcrops immediately to the south suggest that the iron band has been considerably faulted and folded in this vicinity.

Finally, a southeast-trending iron formation band increases in thickness from 250 feet in the south half of claim W.S.11, to 500 feet at the boundary of claim W.S.10 and 12. It thins to the southeast, and where last observed, on the north shore of the small lake in the south-central part of claim W.S.10, it is only 2–5 feet thick.

LITHOLOGY

Northcott Bay Section

Thin, lenticular, discontinuous iron formation bands at the southwest shore of Northcott Bay, Genoa township, are composed of coarse-grained chert, siliceous magnetite, and more or less dark-green, secondary silicates, the components being distributed in irregular, alternating layers ½–1 inch thick. The iron content of the bands probably does not exceed 15 percent; in addition, they contain numerous schist zones up to 10 feet thick.

Stake Lake Section

In claim W.D.715, Genoa township, immediately west of the granite tongue, the iron formation is of a lithologic type common to the Stake Lake section. The principal components are chert, pyrite, siderite, and their metamorphic equivalents—magnetite, pyrrhotite, and secondary silicates. In general, the proportion of metamorphic components is higher to the northeast in proximity to intrusive granite. As outlined below, the sulphide and carbonate components, together with their metamorphic equivalents, are concentrated at the base of the lowest stratigraphic unit of the iron formation.

Individual bands of iron formation are composed of: banded chert, banded chert with sulphide-carbonate zones, or sulphide-carbonate zones alone. The common stratigraphic sequence comprises two or more parallel iron formation bands; the northern band(s) is composed of banded chert alone, and the south band is of sulphide-carbonate with or without associated banded chert. Where directly associated, sulphide-carbonate invariably underlies (to the south) the banded chert. Sulphide-carbonate and banded chert are generally associated in this manner in the lowermost iron formation band throughout the Stake Lake section, with the exception of that part to the east of claim W.D.725; here sulphide-carbonate components constitute a separate band, being separated from banded chert to the north by 100–500 feet of intervening volcanic schist (Fig. 4).

BANDED CHERT MEMBER

The banded chert, whether in isolated occurrence or immediately overlying a sulphide-carbonate zone, is composed of grey, granular chert interbanded with varying proportions of siderite, magnetite, pyrite, pyrrhotite, and secondary silicates. Banding is conspicuously irregular, discontinuous, wispy, and vague, there being numerous mutual gradations, protuberances, and bifurcations of component minerals. Chert layers, which constitute 60–70 percent of the rock, are up to 2 inches thick, whereas the composite interbands are generally less than ½ inch thick.

The general nature of the banded chert member and mineral changes due to metamorphism in the northeastern part of the Stake Lake section are illustrated by the following lithologic examples taken from drillholes extending from southwest to northeast (*see* Fig. 4 for location of diamond-drill intersections). In Drillhole No. 48 the cherty member is composed of interbanded grey, granular chert and fine-grained, yellowish-brown siderite with minor intercalated pyrite; in Drillhole No. 41, the chert is interbanded both with grey siderite containing minor disseminated pyrite and magnetite, and with thin magnetite-grunerite-siderite layers; finally, in Drillhole No. 37, dark-grey, relatively coarse-grained chert is interbanded with an estimated 30 percent of magnetite-grunerite-pyrrhotite layers.

The banded chert is locally brecciated, as is shown in Drillhole No. 29 where angular chert fragments up to 3 inches long are distributed in a sulphide-carbonate matrix. Such brecciation appears to reflect deformation at the time of chert deposition.

Dark-grey to black, carbonaceous zones up to 2 feet thick, composed of fine-grained chert, carbonaceous matter, and sulphides (generally pyrite and pyrrhotite), are locally present within the banded chert or at the contact of the chert with the immediately underlying sulphide-carbonate zone; examples were noted in the core from Drillholes Nos. 33, 34, 35, 36, and 38. The sulphide

components of the carbonaceous zones commonly form small spherical to ellipsoidal concretions up to ¼ inch in diameter distributed in the carbonaceous matter. Tiny flecks of chalcopyrite, galena, and sphalerite are locally associated. It is noted that carbonaceous material was not observed in outcrops or drill core to the northeast, in proximity to the metamorphic influence of younger granite; however, it may originally have been more widely distributed in the iron formation before this metamorphic event.

Minor traces of copper-lead-zinc mineralization are locally present in the banded chert. Typically, traces of one or more of sphalerite, galena, and chalcopyrite, in that general order of abundance, occur either in narrow cross-cutting, quartz-calcite stringers less than ¼ inch wide, or, more rarely, as tiny, irregular clusters of grains within the carbonaceous chert as mentioned above. Such mineralization was observed, or had been previously recorded, in the core from Drillholes Nos. 15, 37, 39, 41, and 42.

The banded chert locally contains up to 30 percent volcanic schist distributed as thin, discreet layers and lenses. The total iron content of the banded chert is probably less than 15 percent.

The upper contact of banded chert with overlying volcanic schist is generally sharp or gradational over several inches of interzoned schist, chert, pyrite-pyrrhotite, and siderite. The relations suggest that significant iron-silica deposition ceased rather abruptly upon resumption of volcanic accumulation.

SULPHIDE-CARBONATE MEMBER

The sulphide-carbonate member, which underlies the banded chert member and is locally separated from it by 100–500 feet of intervening volcanic schist, is a lenticular, irregular unit generally 30–50 feet thick but locally up to 100 feet thick. It is not present everywhere along the strike of the iron formation but generally constitutes a well-defined unit (Fig. 4). It is composed of varying proportions of pyrite, siderite, pyrrhotite, magnetite, chert, graphitic material, and volcanic schist. Small veinlets and pockets of lead-zinc-copper mineralization are locally present. In general, magnetite, pyrrhotite, and pyrite are the main components of the sulphide-carbonate member to the northeast, whereas pyrite and siderite predominate to the southwest. This relative distribution of component minerals reflects (a) higher original sulphide content to the northeast and (b) higher metamorphic grade prevailing in that direction. The following descriptions are based largely upon examination by the author and assistants of drill core taken from the part of the Stake Lake section east of claim W.D.1730 (Figs. 3 and 4) that contains the main iron-bearing zone of the Stackpool east property.

In relatively unaltered phases of iron formation, as present to the southwest, all proportions of siderite to pyrite are present, from grey, dense, structureless siderite to banded, massive to crystalline pyrite. However, the two minerals are normally intimately associated, the lesser component forming at least 25 percent and distributed in irregular, gradational zones up to 3 inches thick, which impart a crude banding to the rock. Some magnetite and pyrrhotite are generally present even in relatively unaltered phases, the magnetite forming small, round grains within the siderite, or larger irregular grains within pyrrhotite, itself marginal to pyrite. In addition, pyrrhotite of possible primary origin forms separate, isolated bands, generally intimately associated with carbonaceous material. Local, thin schist layers and lenses are commonly present.

TABLE II—SUMMARY OF DIAMOND-DRILLING AND ASSAY RESULTS ON THE STACKPOOL MAIN IRON-BEARING ZONE; GENOA AND MARION TOWNSHIPS FROM NORTHEAST TO SOUTHWEST[1]

(Compiled by author from diamond-drill data and partial chemical analyses provided by Stackpool Mining Co. Ltd.)

Hole No.	Ore Intersection		Partial Chemical Analysis			Estimated Mineral Composition (Percent) or Remarks[2]
	Horizontal Width	Vertical Depth	Fe	S	$\frac{Fe}{S}$	
	feet	feet	percent	percent		
13	45	172	40.62	16.38	2.48	mgt (50); po (25); py (25)
12	36	237	32.57	13.22	2.46	not available
1	42	104	48.18	20.5	2.34	not available
2	42	0	40.84	18.54	2.20	not available
3	——	——	——	——	——	no ore
37	33	410	36.26	17.19	2.11	mgt (50); po (25); py (25)
4	37	110	34.95	19.68	1.78	not available
5	79	160	34.68	15.86	2.19	not available
6	48	220	54.11	17.18	2.62	mgt (50); po (25); py (25)
7	44	153	43.13	13.81	3.11	not available
8	30	135	49.18	18.32	2.68	not available
38	20	647	42.80	14.7	2.91	mgt (50); po (30); py (20)
9	26	210	47.0	19.25	2.44	not available
11	11	250	40.68	15.44	2.62	not available
10	35	150	39.58	16.11	2.45	not available
39	21	495	36.1	15.4	2.34	mgt (40); po (40); py (20)
16	33	210	36.70	15.95	2.30	mgt (40); po (30); py (30)
17	35	200	43.30	19.9	2.18	mgt (40); po (30); py (30)
40	32	700	39.24	17.11	2.30	not available[3]
18	69	138	33.2	13.4	2.48	not available
19	66	180	26.8	9.40	2.85	not available
41	27	618	33.44	12.61	2.66	sid (40); mgt (40); py-po (20)
20	32	235	32.82	10.17	3.22	not available
42	24	850	34.85	15.29	2.28	sid (33); mgt (33); py (33)
21	10	216	——	——	——	py (50); sid (40); mgt (10)
43	10	320	——	——	——	py (50); sid (40); mgt (10)
22	33	130	37.10	21.7	1.71	not available
23	25	219	30.50	14.15	2.16	py (70); mgt (30)
44	10	568	——	——	——	po (50); py (30); mgt (20)
25	10	50	21.21	13.73	1.55	py (40); po (40); mgt (20)
26	7	150	32.29	16.25	2.00	py (70); mgt (20); po (10)
45	10	260	——	——	——	po (50); py (30); mgt (20)
27	27	245	——	——	——	py (60); mgt (20); po (20)
28	5–10	180	——	——	——	two narrow py bands
31	14	117	——	——	——	py (50); po (30); mgt (20)
46	5–10	——	——	——	——	sid (40); py (40); mgt (20)
29	102	180	32.72	12.7	2.58	sid (50); py (30); po (10); mgt (10)
31	14	105	32.11	19.36	1.66	py (50); po (30); sid (20)
32	95	276	——	——	——	py (60); po (20); mgt (10); sid (10)
47	no ore	810	——	——	——	——
33	39	170	33.88	12.53	2.70	sid (60); py (40)
34	22	180	29.66	15.10	1.96	sid (50); py (50)
36	40	355	31.68	13.3	2.38	py-po (70); sid (30)
35	27	180	35.67	16.98	2.10	py (60–70); sid (30–40)
48	——	——	——	not available		py (60–70); sid (30–40)
49	5–10	——	——	not available		py (60); po (30); mgt (10)
50	——	——	——	not available		no ore

[1]See also Figure 4.

[2]Based on visual examination of diamond-drill core by author and assistants, 1961—mgt. = magnetite; po = pyrrhotite; py = pyrite; sid = siderite.

[3]Phosphorus content = 0.004 percent.

Although commonly mixed in equal proportions, siderite or pyrite each locally predominates either in specific lateral portions of the Stake Lake section or within different parts of a particular vertical stratigraphic intersection. Regarding lateral zoning; pyrite content exceeds siderite content in the intervals between Drillholes Nos. 22–28, 31–47, and 36–50; however, siderite content exceeds pyrite content in the intervening parts, that is, between Drillholes Nos. 28–31 and 47–36. Regarding vertical zoning; in the centre of the main iron-bearing zone, specifically in Drillholes Nos. 41, 42, and 43, the siderite content, relative to the pyrite content, increases upwards and predominates at the top (north) of the section; that is, the siderite-rich portion of the member therein overlies the pyrite-rich portion. Although varyingly masked by later metamorphic effects, the same general vertical stratigraphic zoning of the primary carbonate and sulphide components was noted in other parts of the section.

In proximity to younger intrusive granite to the northeast, the contents of magnetite, pyrrhotite, and secondary silicates increase proportionately. The alteration of siderite to magnetite and of pyrite to pyrrhotite and magnetite have, in the extreme case, produced a dense, black, relatively coarse-grained, crudely banded, highly magnetic ore. Within the Stackpool main iron-bearing zone all gradations are present, from this highly altered phase to the unaltered siderite-pyrite-(pyrrhotite) phase. The approximate average mineral contents of individual drill intersections, distributed from northeast to southwest in the Stackpool main iron-bearing zone, based on visual estimates of drill core, are listed in Table II. Thus, it is seen that the estimated magnetite content ranges from 50 percent at the northeast (Drillholes Nos. 37 and 38), through 40 percent (Drillholes Nos. 39 and 41) and 30 percent (Drillhole No. 23), to less than 10 percent at the southwest (Drillhole No. 35); the estimated pyrrhotite content decreases correspondingly from 40 percent (Drillhole No. 39) to less than 10 percent. In contrast, the estimated pyrite content ranges from 20 percent at the northeast (Drillhole No. 38) to 70 percent at the southwest (Drillholes Nos. 25, 35, 48); and the estimated siderite content ranges from negligible at the northeast to 70 percent at the southwest (Drillhole No. 33).

The average iron and sulphur contents of 33 intersections of the main iron-bearing zone are listed in Table II. Average iron content ranges from 21.21 percent (Drillhole No. 25) to 49.18 percent (Drillhole No. 8). Higher average iron content present in the northeastern part of the zone (Drillholes Nos. 13–18) reflects relatively high magnetite content, whereas lower average iron (Fe) content to the southwest reflects relatively high siderite-pyrite contents. Average sulphur content fluctuates erratically between 10.17 percent (Drillhole No. 20) and 21.7 percent (Drillhole No. 22) without any recognizable pattern. The ratio Fe/S likewise fluctuates without pattern from a low of 1.55 (Drillhole No. 25) to a high of 3.11 (Drillhole No. 7). In this connection, had the original sulphur content of the Stackpool main iron-bearing zone been uniform along strike, metamorphism to the northeast, by decreasing the original S (and CO_2) content would expectedly have caused (1) lower average S content and (2) higher average Fe content, and hence (3) higher average Fe/S ratios in that direction. That this has not occurred suggests that the original S content to the northeast was in fact, substantially higher than is now apparent. Present relations suggest, therefore, that the Stackpool main iron-bearing zone originally comprised a sulphide(pyrite)-rich facies to the northeast bounded gradationally to the

southwest by a carbonate(siderite)-rich facies, these original relationships now being obscured by metamorphic alterations.

Lead-zinc-copper mineralization is locally present in the sulphide-carbonate member in the form of small quartz-carbonate veinlets and lenticles generally less than ¼ inch thick and a few inches long, containing sphalerite, galena, and chalcopyrite, in that general order of abundance. Occurrences of this type were noted in the core from Drillholes Nos. 5, 25, 26, 27, 41, and 42. Narrow carbonaceous zones similar to those described above (p. 16) in the banded chert member were observed in sulphide-carbonate core from Drillholes Nos. 26, 27, 35, and 44.

Southwest of the Stackpool main iron-rich zone in claims W.D.1730–1732, relatively small, local pockets of disseminated pyrite and siderite are present along the south side of the southern band of iron formation. A small shaft was reportedly sunk on iron formation near the middle of the south boundary of claim W.D.1732 (Moore 1927, p. 91).

In claim W.D.1734 the south band of iron formation comprises a banded chert unit 40 feet thick immediately underlain (to the south) by a massive siderite-pyrite zone up to 60 feet thick; of this width, a thickness of 40–50 feet, composed of roughly equal parts of siderite and pyrite, is exposed intermittently along strike for 500–1,000 feet. In claims W.D.1735 and 1736 to the southwest, the iron formation bands consist predominantly of considerably brecciated, interbanded, white to black chert, siliceous magnetite, and minor siderite, the latter restricted, for the most part, to the south side of the south band.

MIDDLE VOLCANIC ZONE

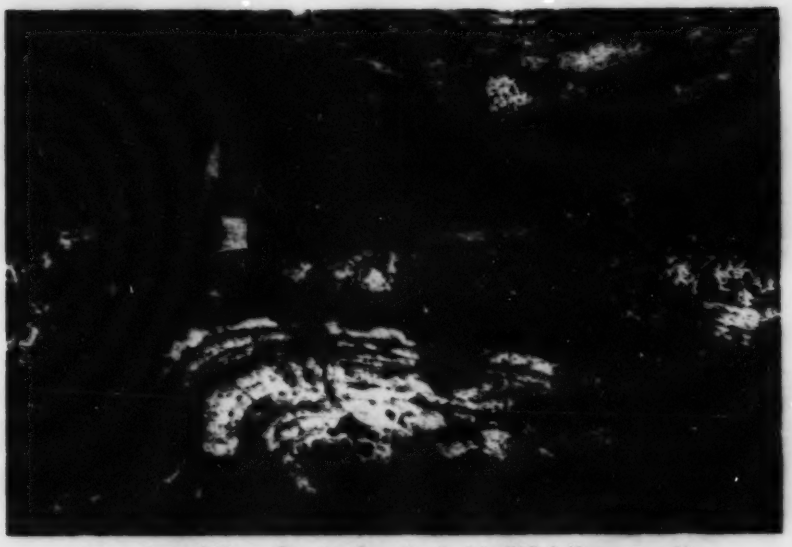
This zone refers to the volcanic rocks lying between the several iron formation bands in the Stake Lake section (Fig. 4).

In general, the middle volcanic zone contains a mixture of acid to basic volcanic material, products of a transitional phase from older predominantly acid, to younger predominantly intermediate volcanic discharge. Grey to green, massive to fragmental, andesitic to basaltic tuff, medium-grey, massive to fragmental dacite, and light-grey rhyolite are present in about equal proportions. The different types of schist are commonly interbanded; 30 feet of light-grey felsite commonly alternating with an equivalent thickness of dark-green, chloritic schist locally interspersed with dense rhyolite. Grey, schistose volcanic rock with abundant round quartz eyes is common, as are fragments up to 4 inches long in a grey-green, chloritic matrix.

Massive to schistose rhyolite is the predominant component of the middle volcanic zone in the northeast (Drillholes Nos. 37 and 38) and central (Drillholes Nos. 45 and 27), parts of the Stackpool east property. Elsewhere, rhyolite intersections are interspersed with predominantly grey-green chloritic schist. Disseminated calcite is commonly associated with the more basic varieties of volcanic rocks. In Drillholes Nos. 46 and 47, a grey intermediate volcanic rock with abundant quartz eyes and small calcite lenticles contains 2–5 percent disseminated pyrite. Several thin bands of medium-grained clastic sedimentary rock composed of small, angular fragments of grey felsite in a gritty matrix of the same composition were noted in Drillhole No. 46. This is one of the rare occurrences of undoubted clastic sedimentary material seen in the map-area.

The chemical compositions of typical volcanic rocks from the middle volcanic zone are shown in Table I (Samples Nos. 7–12). Altered andesites to rhyodacites are represented. The rocks are now largely composed of fine-grained aggregates

Shaly phase of Woman River iron formation, in claim W.S. 3, Marion township.



Jasper phase of Woman River iron formation, in claim W.S. 6, Heenan township.

of secondary minerals. Compared to world averages, the middle volcanic rocks show an apparent enrichment in FeO, CO_2, and H_2O, and apparent loss in SiO_2 and alkalis.

Rush River–Woman River Section

Very thin, discontinuous bands of iron formation, which extend from Rush River to the centre of claim W.S.1, Marion township, are composed of interbanded, dense, dark-grey chert and siliceous magnetite and siderite, the latter two in about equal proportions.

Relatively thick, continuous bands of grey, siliceous, and red jaspery iron formation extend from the centre of claim W.S.1, westward to the Woman River. The siliceous iron formation is composed of bands, ¼–1 inch thick, of white, grey, and green chert with thinner interbands of fine-grained, siliceous magnetite. The chert is unusually dense, appearing chalcedonic in hand specimen; the siliceous magnetite layers are commonly associated with thin bands, lenses, or margins, ¼–½ inch thick, of grey and green secondary silicates. Zones of brecciated iron formation, containing grey, banded chert fragments up to 3 inches long in a dark-grey, dense, siliceous matrix, are not uncommon. The banded chert is locally sideritic.

Jaspery iron formation is common in claim W.S.3; bright red jasper layers, up to 2 inches thick, are generally interbanded with black, magnetite-bearing, chert layers. A schistose, magnetite-rich phase of iron formation, commonly 10–40 feet thick, present along the lower, or south side of the iron formation in the east half of claim W.S.3, is composed of thick grey chert layers, ½–1 inch thick, that alternate with magnetite-silicate-rich, shaly partings of somewhat thinner dimension. This schistose type of iron formation contains approximately one-third chert bands and two-thirds magnetite-bearing bands.

The iron formation in the Rush River–Woman River section mostly is particularly siliceous, with very low iron content. Individual iron formation bands generally contain less than an estimated 15 percent iron. In addition, the iron formation contains considerable interbanded quartz porphyry and volcanic schist. This relationship is well illustrated by a north-south section across 800 feet of typical "iron formation" situated 1,400 feet east of Woman River in claim W.S.3; this section contains nine separate zones of quartz porphyry and volcanic schist, each 5–55 feet thick, the intervening iron bands 15–75 feet thick. Darker varieties of intercalated schist in the vicinity appear to contain carbonaceous material.

Heenan Section

Banded iron formation in Heenan township, at the southwest end of the Woman River iron range, is composed predominantly of banded chert, jasper, and siliceous magnetite; in addition, sideritic and pyritic chert are present locally. The various types of iron formation are considerably intermixed along and across the formation. In general, the highly siliceous types of iron formation, such as banded chert and jasper, predominate: (1) to the northeast in claims W.S.4–6; and (2) elsewhere, along the upper and middle stratigraphic parts of the iron formation bands, including both the northwest-facing band in claims W.S.7–9 and the southwest-facing band in claims W.S.10–12. Within subdivision of rock types, white to grey chert forms the upper stratigraphic zone, and jasper forms the underlying middle stratigraphic zone. In contrast to this distribution of siliceous phases of iron formation, the magnetite- and siderite-

bearing phases, where present, are concentrated at the stratigraphic base of the iron formation bands; for example, at the southeast side of the band in claim W.S.8, and again, at the northeast side of the band in claims W.S.10–12.

Thus, the iron formation, where it is completely developed, displays an upward transition from siliceous magnetite-siderite phase at the base, through jaspery chert and grey-banded chert, to light-grey, banded chert with negligible iron content at the top of the formation. In general, the iron content is estimated to be 30–40 percent at the base of the formation to 5–10 percent at the top. These relationships are illustrated by the following generalized stratigraphic sections, in descending order, taken at different places along the range from northeast to southwest:

1. Iron Formation, south of Claim Lake in claims W.S.4–6

	feet
White to light-grey, banded chert	30–100
Jasper with interbanded dark-grey chert	50–350
Dark-grey chert with siliceous magnetite	70–250
	150–700

2. Iron Formation, underlying the large ridge in claims W.S.8, 9

	feet
White to light-grey, banded chert	70 – 200
Dark-grey, banded chert with jasper zones	300 – 600
Dark-grey, banded chert with magnetite zones	100 – 600
	470–1,400

3. Iron Formation, in claims W.S.10–12, to the southwest

	feet
White to light-grey, banded chert	10–100
Jasper	0–200
Dark-grey chert and siliceous magnetite	0–200
	10–500

The white to light-grey, banded chert phase at the top of the formation is typically composed of white chert bands up to 1 inch thick with thinner, medium-grey, cherty interbands ¼–½ inch thick. Relatively massive beds of light-grey chert several feet thick broken only by very thin, medium-grey cherty laminations are present, as are also massive, bedded cherts of pale-pinkish tint due to sparsely disseminated hematite. Locally, the banded chert contains thin shaly, sideritic or magnetite-bearing parting seams. The total iron content of this part of the iron formation, however, is probably less than 10 percent.

Typical jasper consists of red hematitic chert bands, up to 1 inch thick, alternating with grey to black interbands, ¼–½ inch thick, composed of chert with more or less disseminated magnetite and hematite. There are all transitions, from brilliantly banded maroon and black jasper to grey, banded chert with faint reddish bands. A common variety of jasper consists of finely laminated, red chert bands and grey chert bands, ½–1 inch thick, alternating with thin, dark-grey, magnetite-bearing chert parting layers. The jasper zones grade into and contain zones of dark-grey, banded chert in which grey chert layers, up to 2 inches thick, alternate either with dark-grey to black, magnetite-rich, cherty layers, ¼–½ inch thick, or with thin, magnetite-rich parting seams. Much of the lighter-grey chert is finely laminated in darker-grey shades. Grey chert bands locally contain considerably disseminated crystalline pyrite.

Irregular zones of dark-grey chert with siliceous magnetite are present along the lower side of the iron formations at the southwest end of the range. Chert bands, ½–2 inches thick, alternate with magnetite-rich bands, generally ¼–½ inch thick but locally 6–12 inches thick. Chert bands consist of fine-grained chert with sparsely disseminated, fine-grained magnetite. Magnetite layers are composed of fine-grained magnetite with variable disseminated chert and secondary silicates. The chert and magnetite are both fine-grained, about 200–300 mesh size. Some bands of shaly magnetite contain small patches and segments of siderite variably altered to magnetite; this suggests that siderite was originally a more extensive component than is now apparent. No magnetite-bearing zone was observed that does not contain considerable interbanded chert. The richer magnetite zones are present in claim W.S.8, and in claims W.S.10–12. These zones are further described in the section of this report dealing with economic geology (pp. 46–48).

Relation to Adjacent Formations

The Woman River Iron Formation is everywhere conformable to enclosing volcanic rocks, so far as could be ascertained by examination of exposures and diamond-drill core. In this regard, the banding in the underlying acid pyroclastic rocks and overlying andesitic flows is parallel to the banding in the iron formation itself. There is no evidence of significant erosion or structural disturbance of the acid pyroclastic rocks prior to deposition of iron formation. Furthermore, in the northeastern part of the range the numerous, thin lenses and bands of iron formation are concordantly enclosed in volcanic tuffs, breccias, and flows. On the whole, the evidence suggests that iron formation was deposited mainly upon fresh acid pyroclastic rocks, which were, in turn, soon overlain by intermediate to basic volcanic flows.

ENVIRONMENT OF DEPOSITION

Geological relations indicate that the Woman River Iron Formation was deposited upon a volcanic terrain during an interlude between early acid and later intermediate to basic volcanic discharges. That the iron formation and enclosing volcanic rocks accumulated beneath standing water, whether lake or sea, is suggested by the absence of significant erosion of underlying acid volcanic rocks, by extensive stratigraphic continuity of the iron formation, and by the presence of numerous pillow structures in overlying lava flows. A subaqueous volcanic environment is envisaged, a relatively subdued, gently undulating topography providing an assortment of slopes, flats, and depressions upon which and in which the iron formation was deposited. Although the presence of intervening tuffaceous material between the several parallel iron formation bands to the northeast indicates contemporaneous volcanic accumulation in that part of the area, no comparable contamination seems to have affected the thick iron formation band to the southwest.

Facies distribution in the iron formation, both lateral and vertical, seemingly reflects a varied and changing environment of deposition. The siderite-pyrite-carbon association common in iron formation bands to the northeast suggests a local reducing environment, attributable to relatively deep, stagnant water, or to proximity to volcanic exhalations of reducing character, or to both. Abundant hematitic jasper in iron formation bands to the southwest suggests a local

oxidizing environment such as prevails in relatively shallow, aerated water under the influence of atmospheric oxygen. Furthermore, the pronounced gradational relationship of the facies along the strike of the iron formation suggests that the environment at the time of deposition was equally gradational along strike. These requirements would be generally met in an aqueous volcanic environment, in which a relatively restricted exhalative source area, the site of siderite-pyrite-carbon deposition, sloped gently shoreward along an aerated volcanic platform, the site of chert-jasper deposition.

Vertical zoning of the iron formation, in which basal iron-rich units grade up (and laterally) to silica-rich units, apparently reflects the influence of a time-space environmental progression that favoured early, near-source, predominantly iron deposition and later more distant, predominantly silica deposition. Possibly, the siderite-pyrite-bearing Stake Lake section of the iron range to the northeast, in which the underlying footwall volcanic rocks have been considerably altered down to stratigraphic depths of 200 feet (p. 10), represents a locus of volcanic exhalations, or similar activity, by which large quantities of dissolved iron and silica were contributed to the basin of deposition. An early, high-temperature, reducing environment would favour early, near-source iron carbonate-sulphide deposition; whereas falling temperature would favour later, more distant silica deposition, together with hematite and magnetite under suitable local oxidizing conditions.

According to this interpretation, all major components of the iron formation were contributed to the basin of deposition during the same general period of chemical volcanic activity. Present facies distribution reflects varying environments of deposition, each facies being the product of its own local environment at the time of deposition and consolidation. Later metamorphism has resulted in local mineral changes, particularly in the northeastern part of the range. However, there is little evidence suggesting significant addition of material to the iron formation following consolidation. An economic consequence of this interpretation is that any iron concentrations should be confined to the stratigraphic base of the iron formation.

Intermediate to Basic Volcanic Rocks

Younger volcanic rocks of predominantly intermediate to basic composition overlie the Woman River Iron Formation. A stratigraphic thickness of rocks exceeding 20,000 feet is present in an area that includes most of Heenan township, the northern part of Marion township, and a thin strip along the north boundary of Genoa township.

The member comprises andesite to basalt flows, pyroclastic rocks and thin, shaly, interflow layers, massive dioritic rocks, and rhyolite porphyry and pyroclastic rocks. Of these, andesite flows apparently predominate (Table I, Samples Nos. 13–14). For the most part, the member is composed of a succession of greyish green lava flows, generally 50–100 feet thick but in places up to several hundred feet thick. Individual flows contain massive, pillowed, and breccia zones, the first two predominating. The lavas range from light-grey to dark-green, the darker being the more common. The lava is considerably altered, to varying proportions of plagioclase feldspar, actinolite, chlorite, epidote, zoisite, and carbonate; porphyritic varieties contain euhedral plagioclase and(or) hornblende crystals varyingly altered to white mica, secondary feldspars, chlorite,

epidote, and carbonate. Their general mineralogical character has been well summarized by Bannerman (1934, pp. 48D, 49D) as follows:

> In many cases they consist of felted aggregates of chlorite, actinolite, epidote, a little secondary feldspar, dusts of magnetite, a little pyrite, and the usual minor minerals. In other instances the main mineral constituent is greenish hornblende, with actinolite and some epidote, carbonate, zoisite, small quantities of plagioclase feldspar, and a little quartz. In some of the coarser-grained facies the presence of considerable uralite bespeaks the former pyroxene, and in some cases remnants of the latter mineral were observed. In most instances the ferromagnesian minerals make up by far the greater part of the rock. In some cases as much as 70 percent is hornblende or hornblende and chlorite, the latter commonly occurring as a secondary readjustment of the schist phase, replacing the hornblende.

East of Woman River, small and poorly formed pillow structures are of limited stratigraphic use. West of the river, however, numerous large, well-formed pillow structures serve as excellent stratigraphic top-indicators. Individual pillows are up to 6 feet long and 2 feet wide, but are commonly 1 by 3 feet in size. Mattress- bun- and balloon-shaped pillows are equally common. Amygdaloidal tops and chloritic rims are present. Nests and stringers of white chert commonly occupy pillow interstices. Local shale, greywacke, and cherty interflow layers up to 2 feet thick are present.

The pillows have been locally distorted in conformity with the regional shearing, so that their present direction of elongation does not conform to the strike of the parent lava flow. For example, at the first falls on the Woman River north of the iron formation in Marion township, the pillows are elongated in a direction N.50°W., whereas the enclosing volcanic units trend N.85°E.; individual pillows therein are crudely elliptical, a broad stubby end pointing northwest, and one or more long tapered extensions pointing southeast (Photo p. 9, upper); the blunt, stubby ends, which are commonly rimmed with chloritic material 1–3 inches thick, represent original pillow tops now roughly 45 degrees out of shape, whereas the long tapered extensions are basal to the distorted pillows.

Several volcanic zones, each from a few hundred to several thousand feet thick and composed of grey, dense, highly zoisitized pillow and breccia lava, are present in the interval roughly defined by the iron formation on the south, and by the east-flowing part of the Woman River, in the northwest quarter of Marion township, on the north. Chemical analysis of typical material from one zone in the centre of this interval indicates that the rock is andesitic in composition, and that mineral alteration has resulted in negligible chemical alteration (Table I, sample No. 14).

Numerous flow breccia zones, each generally less than 6 feet thick and composed of greyish green, lenticular, andesitic fragments, up to 6 inches long, in a fine-grained, andesitic matrix, are associated with the lava flows.

Numerous thin zones of acid pyroclastic rocks, indiscriminately scattered throughout the intermediate to basic volcanic rock sequence, indicate that some acid volcanic discharge continued during accumulation of the younger, predominantly intermediate to basic portion of the volcanic pile. For example, a zone, 60 feet thick, exposed at the northwest corner of Northcott Bay, Genoa township, is composed of angular rhyolite fragments up to 6 inches long and of decreasing upward size, in a fine-grained rhyolitic matrix.

A sizeable mass of rhyolite porphyry extends from the junction of Woman and Rush rivers, Marion township, westward to the west boundary of Heenan township, 8 miles distant. From a maximum width of 7,500 feet at the centre of Heenan township, this mass thins gradually to the east but abruptly to the west. The porphyry typically contains prominent, round, glassy quartz eyes, commonly

shattered and distorted, in a highly schistose quartz-feldspar-sericite matrix. Plagioclase phenocrysts, occasionally sheared out, are locally present. In general, proportion and size of phenocrysts decrease to the west. The mass contains specific zones of undetermined size composed of recognizable pyroclastic material. So far as is known, the rhyolite porphyry mass is everywhere concordant with enclosing volcanic rocks. Metamorphic and crosscutting relationships with

Distorted pillow structures in andesite lava flow at main falls north of iron formation; Woman River, Marion township. Pillow tops are in direction of thick chloritic selvages and roughly in line with hammer handle.

adjacent volcanic rocks were not observed. Although its precise origin is in doubt, the lithology and its association with pyroclastic rocks suggest a volcanic kinship. Accordingly, it is tentatively assigned to an extrusive or subjacent intrusive phase of the acid volcanism.

Similar relationships prevail with respect to numerous, large, sill-like to subconcordant masses of massive to porphyritic diorite present in the predominantly andesitic flow sequence. The largest of these, which extends across the north boundary of Heenan township projecting eastward into Marion township

and is up to 6,000 feet wide, coincides in strike with a major synclinal fold-axis. However, most of such dioritic masses are less than 200 feet thick and of limited stratigraphic distribution. The diorite masses so referred to are structurally concordant with, similar in mineral composition to, and have had no recognized metamorphic influence upon, adjacent volcanic flows. They appear for the most part to represent central portions of thicker flows, volcanic vents, feeders, and (or) associated sills and dikes related to one or other of the andesitic phases of the accumulating volcanic pile.

ACID INTRUSIONS

The main mass of acid intrusive rock, situated near Rush Lake on the east, is composed of massive to gneissic granite, granodiorite, and syenite. It forms the west margin of a large regional mass that extends many miles to the east. Within the map-area this relatively homogeneous granitic mass is margined in the northeast quarter of Marion township by numerous clusters of granite sills and dikes, which penetrate the older volcanic and sedimentary rocks; and in the southeast quarter of the same township by a "granite-diorite" complex up to 8,000 feet wide, in which diorite and granitic rocks are so intimately interfingered that separation of the two proved impracticable. In addition, isolated masses of granitic rocks, ranging in size from narrow sills to large, irregular stocks, 4,000 feet in diameter, are present in the volcanic rocks and banded iron formation at considerable distances west of the main granite contact; some of the isolated granitic masses may be related to the main granite mass, whereas others may be allied to these older acid volcanic rocks.

Grey to pink, medium-grained, massive, hornblende-biotite granite is the most common acid intrusive rock. Although commonly massive, a faint alignment of platy minerals and of xenoliths was observed in many outcrops. Any such planar element is normally parallel to adjacent granite-greenstone contacts. Coarse-grained and porphyritic varieties of granite are not uncommon. Pegmatitic phases are rare.

Zones of pinkish grey, medium-grained, mottled hornblende syenite are locally present, as for example at the southwest entrance to Rush River. Numerous zones of grey, fine- to medium-grained, hornblende granodiorite alternate with normal grey granite particularly in proximity to volcanic contacts.

In the vicinity of Oldscamp Lake to the northeast the granite–acid volcanic contact zone is up to 2,000 feet wide; it comprises, from south to north: faintly gneissic granite with increasing acid schist content in the form of small inclusions and larger patches and zones; through migmatitic interlayering of schist and gneiss; to acid schist with decreasing proportions of granite sills, dikes, and small irregular masses.

Quartz and quartz-epidote stringers are common in the massive granite. At the southwest entrance to Northcott Bay, Rush Lake, numerous joint planes are thinly coated with blue, scaly, alkalic hornblende, probably riebeckite.

Typical granite from the northwest shore of Rush Lake is a grey to pale-pink, medium- to coarse-grained rock composed predominantly of euhedral to subhedral feldspar, mainly albite but with some microcline, and quartz together with subordinate interstitial biotite, hornblende, white mica, and calcite. Grey, medium-grained, slightly schistose granite from the northwest quarter of Genoa township contains large albite and orthoclase crystals moderately altered to argillaceous material and white mica, together with occasional grains of chlori-

tized biotite and hornblende in a fine-grained feldspar-quartz-white mica-apatite matrix. Coarse-grained quartz-feldspar porphyry, which forms a narrow sill in volcanic schist near the margin of the granite mass in Genoa township, contains quartz and albite crystals, up to ¼ inch long, in a quartz-feldspar matrix with 5–10 percent amphibole and rare biotite.

The smaller granitic masses present in the older volcanic and sedimentary rocks are characteristically porphyritic. They range from narrow sills and dikes up to large irregular masses 4,000 feet long. Swarms of the smaller bodies, ranging from aphanitic to porphyritic in texture, are present in the volcanic rocks and iron formation in the northwest quarter of Genoa township and the east half of Marion township. Coarse-grained quartz-feldspar porphyry, from a narrow sill in volcanic schist near the margin of the main granite mass in Genoa township, contains albite and quartz crystals, up to ¼ inch in diameter, in a fine-grained, quartz-feldspar-amphibole matrix, which, in addition, contains occasional, partly chloritized biotite flakes.

An elliptical stock of reddish grey, medium-grained, biotite granite, 4,000 feet long and up to 1,500 feet wide, which extends across the northwestern part of claim W.S.1, Marion township, and fingers out northeastward in the form of numerous, narrow sills, is composed of euhedral to subhedral, partly altered soda plagioclase, quartz, and biotite, traces of apatite and calcite, and 2–5 percent disseminated pyrite.

DIORITIC INTRUSIONS

Younger dioritic intrusions of variable size are present in the volcanic, sedimentary, and granitic rocks. They are most abundant west of the main granitic mass in the south half of Marion township. Here they form sill- and dike-swarms, each unit of which is 1–5 feet thick; larger individual sills and dikes up to 50 feet thick; and large, irregular, lenticular masses up to several miles long. Most of the younger diorite has invaded granitic and acid volcanic rocks; however, sizeable masses are also present in the intermediate to basic volcanic rocks. Younger diorite closely resembles fresher phases of the older diorite of presumed volcanic kinship (pp. 26–28); differentiation of the two is based largely on the fresh appearance, homogeneous composition, and structural discordance of the younger diorite, in contrast to altered appearance and gradational relations of the older diorite with enclosing andesitic volcanic rocks. However, differentiation of specific diorite units is often difficult and occasionally impossible to make with any certainty. It is also possible that more than two ages of diorite are present.

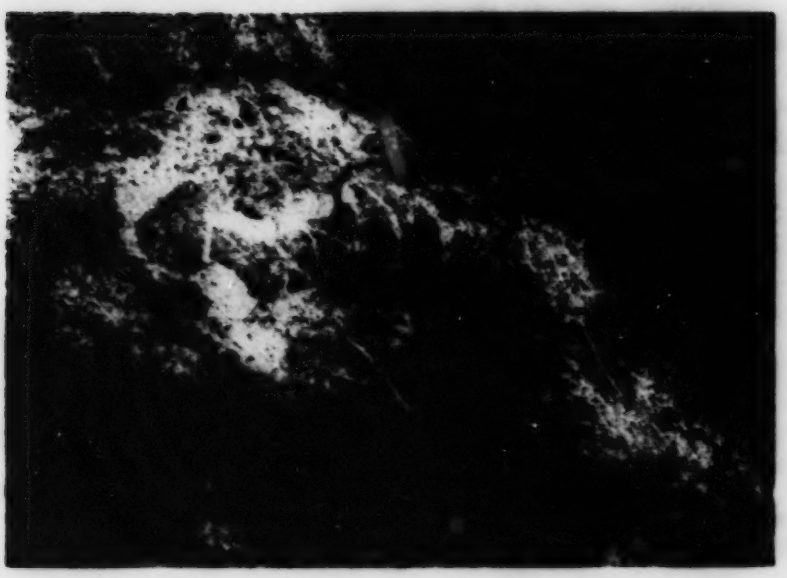
Rock types range from quartz diorite to gabbro, the common variety being greyish green, fine- to medium-grained, massive to porphyritic diorite. Typical diorite from near Strata Lake, Marion township, is a grey-green, fine- to medium-grained, mottled textured rock composed of interlocking aggregates of relatively fresh, euhedral oligoclase-andesine and somewhat chloritized amphibole, with accessory ilmenite, pyrite, and quartz. Dark-grey, fine-grained diorite containing 5–10 percent disseminated magnetite is present in acid breccia ⅛ mile northeast of Oldscamp Lake, Marion township. Many irregular dikes and smaller masses of diorite have a pronounced diabasic texture. Porphyritic varieties containing white feldspar crystals up to ½ inch long are present, as, for example, midway between Rush River and Opeepeesway River in the southern part of

Marion township. Dark-green, porphyritic quartz diorite is also present. Sills of coarse, pegmatitic diorite, each 1–3 feet thick, transect medium-grained, massive diorite 1½ miles west of Woman River in the southeast quarter of Heenan township. On the east bank of a small round lake, ¾ mile west of Rush River and 1 mile north of Puppet Lake, Marion township, fresh diorite in dike form was observed intrusive into diorite of seemingly identical composition, thereby demonstrating multiple injection of dioritic material.

Chilled contact of younger diorite (right) against medium-grained granite (left).

A series of irregular, dike-like masses of dark-green, fine- to medium-grained diorite with general northwest trend have intruded granite along the shores of Rush River, Marion township. In many excellent exposures in that area, chilled diorite may be observed against medium-grained granite, confirming that diorite is the younger rock.

So far as determined, only the older diorites of presumed volcanic kinship (pp. 38, 39) are cut by granite; that is to say, granite was not observed intrusive into fresh diorite of apparent younger age. For this reason, intrusion of the younger diorite is interpreted as a later event than the main granite intrusion. This interpretation of the sequence of events is contrary to that of Bannerman (1934, p. 68D), who postulated that quartz and feldspar porphyry emplacement followed the younger basic intrusions. The problem is concerned with the proper age classification of specific dioritic intrusions, whether they should be assigned to the older or to the younger period of diorite intrusion. Final settlement of this problem would seem to require more detailed field work.



Quartz breccia with fragments of diorite, granite, and greenstone, west shore of Rush River, east of Puppet Lake, Marion township.

Lamprophyre dikes were observed cutting all other volcanic, sedimentary, and igneous rocks with the exception of the later diabase dikes. The lamprophyre dikes, generally 1–5 feet wide and trending sinuously through the host rocks, are typically composed of large books of fresh to partly chloritized biotite, hornblende, feldspar, and occasionally quartz. Altered varieties contain considerable epidote and carbonate. The relative ages of lamprophyre, diorite, and acid volcanic rocks are well illustrated in an outcrop, ¼ mile northeast of Opeepeesway River, Marion township, where both rhyolite breccia and a transecting diorite dike with chilled contacts are cut, in turn, by a 2-foot-wide lamprophyre dike.

LATE DIABASE INTRUSIONS

Numerous north- to northwest-trending, steeply inclined, continuous diabase dikes, similar in composition and distribution to those present in many parts of the Canadian Shield, transect all other rocks of the map-area. Measured widths range from 10 to 90 feet and average 35 feet.

The common diabase is dark-grey to black on fresh surface, weathering to light-grey, and is composed of pyroxene and feldspar in typical ophitic association with minor biotite, quartz, and magnetite. Porphyritic varieties contain large greyish white feldspar crystals or clusters of crystals, particularly towards the margins of the dike. A second common type of diabase is brown on fresh surface, has a distinct mottled texture, and contains accessory olivine rather than quartz. The relation between the two types of diabase was not established.

PLEISTOCENE AND RECENT

Pleistocene deposits of sand, gravel, and boulder till are plentiful in the map-area. They generally form a thin mantle of unconsolidated debris unevenly distributed over the irregular rock surface. Locally, however, as for example immediately west of Woman River, thick deposits of sand are present. The boulders of the till sheets are largely granitic in composition; they are commonly up to 3 feet in diameter. The over-riding action of the ice sheet is attested to by numerous glacial striae, flutings, and chatter marks present on the bedrock of the highest ridges. The glacial marks indicate that the ice moved in a direction between south and S.30°W.

Recent deposits consist largely of peaty and other organic deposits of marsh and swamp environments. They form extensive tracts in southwestern Marion township and along Heenan Creek to the west. There has been considerable reworking of Pleistocene sand deposits along the course of the main streams, particularly Woman and Rush rivers.

Structural Geology

Summary Statement

The rocks of the area have been extensively folded, faulted, and sheared. Principal folds comprise the west-facing, steeply plunging Woman River anticline, the axis of which crosses the south boundary of the map-area; and an adjacent syncline to the north, mainly in Heenan township. Numerous, steeply inclined, transverse faults are present, of limited displacement and bearing N.30°–65°W. Volcanic and sedimentary rocks display pronounced schistosity, with east-west strike and steep to vertical dip.

Stratigraphic tops are indicated by: (1) pillow shapes in lava flows; and (2) to a lesser extent by graded pyroclastic layers; as well as (3) the stratigraphic arrangement in iron formation where chert-rich units overlie iron-rich units.

Folding

The Woman River Iron Formation and adjoining volcanic rocks lie on the northwest limb and nose of the west-facing, steeply plunging, Woman River anticline. The form and attitude of that part of the fold within the map-area have been defined by determinations of stratigraphic tops, bedding attitudes, and local structural plunge.

Pillow shapes and graded layers in Genoa and Marion townships all indicate tops north. In the south half of Heenan township, however, stratigraphic tops gradually change in direction from north through northwest to west, and, finally, in the vicinity of claims W.S.10 and 12, to southwest, thereby tracing out the west-facing anticlinal nose.

The position of basal iron-rich zones within the iron formation conforms to this west-facing anticlinal structure as follows. In Genoa and Marion townships sulphide-siderite units lie south of banded chert units, thereby indicating tops north. In claim W.S.8, Heenan township, magnetite-rich material lies southeast, and in claims W.S.10–12, Heenan township, northeast, of relatively pure-banded chert units, thereby indicating tops to the northwest and southwest respectively.

The attitude of linear elements, such as are formed by dragfolds, cleavages, alignment of lenticular fragments and long crystals, etc., indicate that the Woman River anticline has a steep to vertical plunge. In Genoa township, plunge determinations are equally divided between those steeply west and those steeply east; near Rush River, Marion township, numerous determinations indicate a vertical to steep northwest plunge; and in Heenan township, dragfolds in the iron formation plunge steeply northeast. Thus, available evidence suggests a prevailing near-vertical plunge, with local divergences both to the east and to the west.

The attitude of the north limb and the west nose of the Woman River anticline is revealed by the bedding attitude of iron formation and adjoining lava flows. In Genoa and Marion townships, the bedding ranges in dip from steeply south to steeply north, indicating that here the fold limb is upright to slightly overturned to the north. In Heenan township, southwest-trending beds vary in attitude from vertical to steeply southeast, again indicating local overturning of the fold limb, in this case to the northwest; and to the south, in claims W.S.10–12, Heenan township, southeast-trending beds dip 60°–70°NE., thereby indicating considerable overturning to the southwest of this portion of the fold limb.

Pillow shapes in lava flows indicate that an east-west-trending synclinal fold axis crosses the northern parts of Heenan and Marion townships (Fig. 3). Thus, although pillow shapes indicate tops south along the north boundaries of this township and Marion township to the east, the axis of the presumed syncline coincides with an east-west-trending belt of massive, dioritic volcanic rocks in Heenan and Marion townships.

Most volcanic rocks in the map-area have a well-developed schistosity of general east-west strike and steep to vertical dip. The trend of schistosity is thereby up to 90 degrees at variance with local bedding trends in the iron formation and adjacent volcanic rocks. In detail, the attitude of the schistosity varies across the map-area as follows (Fig. 3): in Genoa township to the east it strikes N.85°W. and dips vertical to steeply south; from east to west across Marion township the strike gradually swings from east-west, to N.80°E., and finally to N.80°W., the dip ranging from vertical to steeply north throughout this interval; and in Heenan township the strike is generally N.85°W., the dip ranging from vertical to steeply north. These gradual changes in attitude of the schistosity probably correspond to the sinuous habit of the main folds.

Faulting

Numerous transverse faults are present in the area. Some are revealed by prominent topographic features and others by horizontal offsets in bedding trends, notably of the banded iron formation. Most faults have a northwest strike, steep to vertical dip, and left-hand horizontal displacement.

The most prominent fault in the area underlies Rush River in Marion township. The fault plane strikes N.33°W. and dips about 65°NE. Horizontal offset is negligible, as indicated by the essential continuity across Rush River of the banded iron formation. At a point on the east shore of the river, due east of the north end of Puppet Lake, slickensides plunge 65 degrees at a bearing of N.10°W.; their shape clearly indicates that at this point massive granite to the northeast has been upthrust to the southwest over highly sheared diorite. The Rush River fault contains large masses of white to grey, massive to vuggy quartz;

for example, a large quartz vein, at least 110 feet wide, exposed on the west bank of the Rush River at a point 1,400 feet north of the southwest entrance of Rush Lake, contains abundant angular fragments of diorite, granite, and volcanic rocks. Smaller quartz veins occupy similarly oriented fractures throughout the area, but particularly in the vicinity of Rush River. Such quartz veins generally lack sulphides.

Numerous transverse faults, which cross the iron range, have resulted in many local offsets. From east to west, the strike of the faults gradually changes from northwest to west-northwest as illustrated in Figure 3. Fault movements have generally resulted in left-hand horizontal offsets up to 2,000 feet. In exception, however, in claims W.S.9–11, Heenan township, an inferred fault with apparent right-hand horizontal offset of 3,000–5,000 feet is present beneath drift cover. The vertical components of the fault movements are undetermined.

On the east bank of Rush River, ¾ mile north of the southeast entrance to Rush Lake, in the southeast quarter of Marion township, highly sheared, sulphide impregnated diorite (*see* p. 53) may reflect local faulting with strike N.64°W. and vertical dip.

Economic Geology

Summary Statement

The map-area has been explored at various times and to varying degrees for iron, lead-zinc, and gold deposits. Despite this activity there has been no ore production to date.

Iron-rich zones are present within the iron formation: (1) on claims W.D.715–728 and W.D.1729–1736, in the east; and (2) on claims W.S.8 and W.S.10–12, in the west. The eastern area, so defined, contains bands and lenses of iron, present mainly in the form of magnetite, pyrite, pyrrhotite, and siderite; detailed diamond-drilling on claims W.D.715–728 and W.D.1729, combined with surface exploration and limited drilling on claims W.D.1730–1736 to the west, has shown that the iron-rich material is present in relatively small and discontinuous lenses and bands. An estimated 500,000 tons of iron-rich material per 100 feet of vertical depth is present on the east group of claims (W.D.715–728 and W.D.1729–1736). The material contains significant amounts of silica and sulphur and would therefore require some metallurgical treatment. Concentration tests indicate that magnetic separation produces a high iron concentrate with a low but significant content of insoluble sulphur. In addition, the weight-percent recovery is low. The future of this eastern iron-rich zone apparently depends on the emergence of a local demand for such a high-sulphur specialty ore.

The Woman River iron formation reaches its maximum width of 1,400 feet on claim W.S.8, Heenan township. Although a large amount of iron is present in the iron formation it is of too low a grade and present in too great a variety of minerals (hematite, magnetite, siderite, sulphides, silicates, etc.) to be of economic value in the foreseeable future. Two small iron-rich zones composed of marginal concentrating-grade material are present at the stratigraphic base of the formation on claims W.S.8 and W.S.10, respectively. The future of the iron formation west of Woman River seems to depend partly upon extending the known iron-rich surface zones, but mainly upon locating additional zones at depth. In this connection only limited surface exploration and no diamond-drilling has been done so far in the vicinity.

Lead-zinc mineralization is present in banded iron formation at the northeast end of the iron range, mainly on claim W.D.717, Genoa township. About 37,000 feet of detailed diamond-drilling has indicated values up to 4.97 percent lead and 3.27 percent zinc across 17.5 feet of core length. Work to date indicates that the mineralization consists of relatively thin, isolated stringers and pockets that lack the necessary continuity. Because the drilling may yet reveal a significant concentration, however, this remains to be proven. All lead-zinc mineralization noted so far is located in the northeast end of the range, specifically east of claim W.D.726, where most of the exploration and drilling have been concentrated. Similar mineralization may be uncovered in the iron formation and adjoining volcanic rocks to the southwest.

Gold values have been reported within and marginal to small granite porphyry and syenite stocks in volcanic rocks close to the iron formation in Marion and Heenan townships. Similar stocks, dikes, and small sills that occur in the area, particularly on claims W.S.1–3, Marion township, east of Woman River, merit further attention. Furthermore, attention should be directed to disseminated pyrite and magnetite present in massive phases of the acid volcanic rocks south of the iron formation as, for example, on the southeastern part of claim W.S.8 and the east half of claim W.S.9 and vicinity, Heenan township.

Description of Properties

IRON

Stackpool Mining and Holding Corporation Limited

In October 1962, Stackpool Mining Company Limited was renamed Stackpool Mining and Holding Corporation Limited. It was formerly known as Central Sudbury Lead-Zinc Mines Limited, and controls the Woman River iron range east of Rush River except for the extreme eastern extension in central Genoa township (Fig. 3). In addition, Stackpool Mining Company Limited formerly controlled 30 mining claims covering the iron range lying between Woman and Rush rivers, Marion township. These two adjacent properties are referred to by the company as the East and West properties, respectively.

EAST PROPERTY

Location and Access

In 1961 the East property comprised the following 23 patented claims continuous from W.D.715 on the east to W.D.1736 on the west: in Genoa township, W.D.715–720 inclusive, S.3693, and S.3694; and in Marion township, W.D.721, W.D.723–727 inclusive, and W.D.1728–1736 inclusive. This claim group covers that part of the iron range extending from the north tongue of granite in Genoa township, on the east, to Rush River, Marion township, on the west, a strike length of 5 miles (Fig. 3).

The property may be reached on the east by a tote road 4 miles long between Rush Lake and Stake Lake, and on the west by way of Rush River at the southwest end of Rush Lake.

History

The property was first acquired in 1908 by Jefferson Mining Corporation, following discovery of several bodies of high-sulphur iron ore by W. D. Smith. In 1910, about 4,000 feet of diamond-drilling was completed in search of iron ore.

At that time, some galena, sphalerite, and chalcopyrite was encountered in one of the drillholes on claim W.D.717; as a result, in 1912 an 8-foot-deep test pit was put down on the best lead-zinc showing on this claim. Additional drilling was done in 1928 and 1929 to further test the lead-zinc mineralization on claim W.D.717. The property was subsequently acquired by Excelsior Mines Limited, and work on the property was carried out by Central Sudbury Lead-Zinc Mines Limited. In 1950–51, 23 diamond-drillholes, totalling 6,300 feet, were put down to test the mineralization on the eastern part of claim W.D.717. A magnetometer survey was completed on covering claims W.D.715–721, W.D.723–727, and W.D.1728.

The property is now controlled by Stackpool Mining and Holding Corporation Limited formerly known as Stackpool Mining Company Limited and before that as Central Sudbury Lead-Zinc Mines Limited. In 1957–58, Stackpool completed 27,747 feet of diamond-drilling along 14,000 feet of the iron range covered by claims W.D.715–719, 721, 723–728, and 1729. In addition, electromagnetic surveys were made of claims W.D.715, 717–719, and 721.

General Geology

The banded iron formation containing the iron deposits lies at the contact between underlying acid pyroclastic rocks and overlying intermediate to basic volcanic flows and massive dioritic rocks. The rocks strike N.70°E., dip vertical to steeply south, and face north. They have been intruded by numerous granitic and dioritic sills, dikes, and irregular tongues. Numerous northwest-trending diabase dikes are also present.

The underlying acid volcanic rocks are predominantly fragmental types, the common member being grey to white breccia composed of whitish, angular fragments, generally 1–4 inches but up to 12 inches long, in a white to dark-grey, felsitic matrix; all ratios of fragments to matrix are represented. More massive tuffaceous types with occasional fragments, massive porphyritic types without discernible fragments, and occasional zones of andesitic volcanic rocks ranging up to several hundred feet thick are present. Within a stratigraphic interval of 50–200 feet from the overlying iron formation, the volcanic breccia has been increasingly altered to dark-green, ferruginous chlorite and sideritic carbonate. To the east, in proximity to intrusive granite, the volcanic rocks locally contain garnet and staurolite metacrysts.

The iron formation comprises two and occasionally three parallel iron bands. The north band(s) is typically composed of banded chert with minor siderite, magnetite, pyrite, and pyrrhotite. The south band, the main iron-bearing zone, which is commonly 35 feet thick but may be up to 100 feet thick, is composed of varying proportions of pyrite, siderite, magnetite, pyrrhotite, chert, and silicate minerals. In the southwestern part of the East property (claims W.D.725–728 and W.D.1729–1736) the south band, or main iron-bearing zone, contains two contiguous members: an upper banded chert member to the north and a lower sulphide-carbonate member to the south. To the northeast, however, in claims W.D.716–724, the sulphide-carbonate member, or main iron-bearing zone, is separated for the most part from banded chert to the north by 100–500 feet of assorted acid to basic volcanic rocks; this is called the middle volcanic zone.

Volcanic rocks overlying the iron formation are mainly andesitic to basaltic flows and pyroclastic rocks. At the northeast end of the property these rocks have been variously metamorphosed to fine- to medium-grained, massive to schistose amphibolite.

Sills, dikes, and irregular masses of granite porphyry, diorite, and lamprophyre up to 20 feet thick are present in the iron formation and adjoining volcanic rocks. In addition, numerous diabase dikes up to 50 feet wide transect all the older rocks.

Iron-bearing Deposits

Distribution and Thickness

The main iron-bearing zone corresponds to the south band of the iron formation. The distribution of this zone in the eastern part of the east property (claims W.D.715–728, W.D.1729), as illustrated in Figure 4, is based upon detailed traversing by the author and assistants off the baselines (Stackpool Baseline, 1957, and Main Baseline, 1961), together with detailed diamond-drill data obtained during the 1957–58 drilling program, provided by Stackpool Mining Company Limited. The main iron-bearing zone follows a sinuous, discontinuous course across this part of the property reflecting original lenticular habit in conjunction with local folding and faulting. In detail, the zone extends from Drillhole No. 13 on claim W.D.715 on the east, to the centre of claim W.D.721, 3,600 feet west (Fig. 4); at this point, faulting of right-hand horizontal offset, has moved it 400 feet north. West of this point, the zone is continuous as far as the west boundary of claim W.D.727, where it lenses-out, resuming in parallel distribution 100 feet south, whence it extends continuously to Drillhole No. 50 on claim W.D.1729 on the west.

Within this interval, the thickness of the main iron-bearing zone varies considerably; this largely reflects its lenticular habit along strike and down dip. Widths encountered in the 1957–58 drilling are up to a maximum of 102 feet in Drillhole No. 29 (Table I). As calculated by the present author, the average horizontal width of potential ore-grade material cut in 38 drillholes is 35.2 feet. Because the zone has a nearly vertical dip, the horizontal width corresponds closely to the true thickness.

Information concerning the distribution and nature of the iron-bearing zone on claims W.D.1730–1736 to the west is more limited, and recourse is had mainly to older records summarized by E. S. Moore (1927, pp. 90, 91). In general, the iron-bearing zone consists of relatively small and disconnected lenses that need to be considered separately for mining purposes. Iron formation on claims W.D.1730 and 1731 is very thin, discontinuous, and of low grade. On claim W.D.1732 a test pit was sunk in iron formation near the middle of the south boundary. In claims W.D.1734, two lenses of iron-rich material, each 40–50 feet wide and 300–500 feet long, lie at the south side of banded chert. Several smaller lenses are reported on claims W.D.1735 and 1736.

Composition

The main iron-bearing zone is composed of varying proportions of pyrite, siderite, pyrrhotite, magnetite, and siliceous impurities. The approximate ratios of main mineral components present, based upon visual examination of the 1957–58 diamond-drillcore by the author and his assistants, is presented in Table II. In general, pyrite and siderite predominate west of Drillhole No. 41, whereas to the east, in proximity to intrusive granite, magnetite, pyrite, and pyrrhotite, are present in roughly equal proportions; in Drillhole No. 39 the magnetite and pyrrhotite contents each exceeds that of pyrite; and in Drillhole No. 43, pyrite and siderite predominate in that approximate order, with magnetite subordinate and pyrrhotite insignificant.

Fresh, unaltered pyrite-siderite material, as present in the core of Drillhole No. 43, comprises a fine-grained, intimate aggregate of massive to crystalline pyrite and dense, buff to dark-brown siderite. The pyrite is commonly concentrated within the siderite in irregular bands, each ¼–½ inch thick, that impart a banded structure to the rock. Elsewhere, pyrite and siderite are intimately mingled without evidence of layering.

In more highly altered material, as present to the east, the pyrite, which is typically present in anhedral to subhedral, locally aggregated grains, is rimmed with or encloses irregular particles of pyrrhotite. Disseminations of moderately fine- to coarse-grained magnetite (−48 to +65 mesh) are present in the sulphide minerals and gangue alike.

Carbonaceous zones up to a foot thick, containing disseminated, fine-grained graphitic material and associated pyrrhotite, are present locally, as in Drillholes Nos. 33, 44, 26, and 27. This distribution is pertinent to any consideration given to geophysical search for conductive zones (e.g. an electromagnetic survey).

Small veinlets and blebs of galena, sphalerite, and rare chalcopyrite in a carbonate matrix, rarely more than ½ inch wide, are present, particularly in cherty parts of the iron-bearing zone (*see* pp. 16, 17, 20).

Tonnage Estimate

The following tonnage and grade estimates have been prepared by the author unless otherwise stated. The estimates are based mainly upon the following diamond-drill and assay information provided by Stackpool Mining Company Limited: (1) a property plan showing collar locations and horizontal projections of 49 drillholes (1957–58 program); (2) cross-sections of diamond-drillholes, showing subsurface intersection of the iron-bearing zone together with surface topography and geology where known; and (3) assay results, specifically Fe and S contents of consecutive samples (generally 10–15 feet long) taken along the intersections of the iron-bearing material cut by a drillhole, measured along the length of the hole. Horizontal width of the iron-bearing zone is measured at the mid-point of the intersection, due allowance being made for local dip. Because the majority of holes were drilled perpendicular to the strike of a steeply inclined to vertical iron-bearing zone, horizontal width closely approximates true width. An assay cut-off of 20 percent Fe was used to define the boundaries of the iron-bearing zone.

The author estimates, on the basis of the drilling and assay data provided by Stackpool Mining Company Limited, together with his visual examination of drillcore and outcrops, that the most promising portion of the Stackpool main iron-bearing zone, in terms of combined thickness and continuity, extends for 7,000 feet along strike from Drillhole No. 13 on the east to Drillhole No. 23 on the west (*see* Fig. 4). The horizontal widths of potential ore-grade material (not less than 20 percent Fe) in this interval range from 11 to 79 feet, the average horizontal width being 38.2 feet. These dimensions provide an ore potential in this portion of the property of 27,000 tons per vertical foot, or 2,700,000 tons per vertical depth of 100 feet.

West of Drillhole No. 23, the iron-bearing zone is relatively erratic in thickness and distribution. Considering first the strike interval of 6,000 feet, extending from Drillhole No. 44 on the east to Drillhole No. 50 on the west (Fig. 4), the horizontal widths of potential ore-grade material encountered in the 1957–58 drilling program range from 0 to 102 feet. Adjacent horizontal widths in this interval fluctuate widely (Table II). The average horizontal width, based upon

17 available drill intersections in this interval, is 25 feet. However, excluding two excessive widths encountered (Drillholes Nos. 29 and 32), the average horizontal width of the remaining fifteen intersections is only 15 feet. These dimensions provide a potential in the interval from Drillhole No. 44 to Drillhole No. 50 of 9,000 tons per vertical foot, or about 900,000 tons per vertical depth of 100 feet.

The further extension of the iron-bearing zone to Rush River, 18,000 feet west, which is covered by claims W.D.1731–1736 inclusive, is characterized by an apparently thin and erratic distribution. Any ore-grade material present in this portion of the property would presumably be in relatively small and discontinuous deposits. E. S. Moore (1927, p. 91), who examined the deposits in 1925, estimated that, in this portion of the property, there is 1,500,000 tons of ore containing 40 percent iron, on the average, to a depth of 100 feet. However, this remains to be tested.

Table III summarizes the potential ore estimated to be present on the East property of Stackpool Mining Company Limited, per vertical depth of 100 feet:

TABLE III—POTENTIAL ORE; EAST PROPERTY, STACKPOOL MINING COMPANY LIMITED

Claim Group	Length Along Strike	Potential Ore	Estimated By
	feet	tons	
W.D.715–723	7,000	2,700,000	A. M. Goodwin (1961)
W.D.724–728, W.D.1729	6,000	900,000	A. M. Goodwin (1961)
W.D.1730–1736	18,000	1,500,000	E. S. Moore (1926)
Total	31,000	5,100,000	———

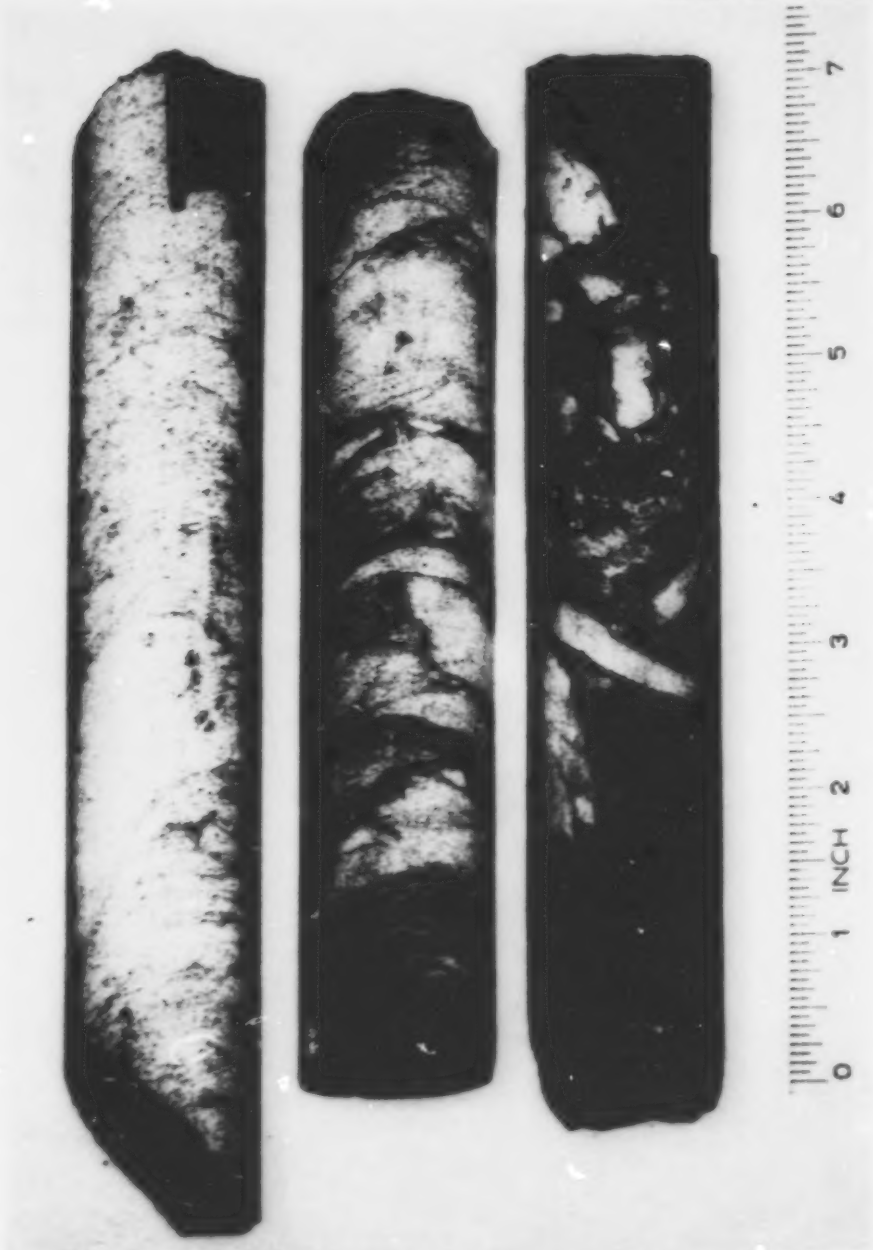
Grade

As calculated by the author, in the strike interval of 13,000 feet extending from Drillhole No. 13 on the east to Drillhole No. 50 on the west, the weighted average grade of the Stackpool main iron-bearing zone, based upon partial assays provided by Stackpool Mining Company Limited of consecutive samples from 33 complete intersections, is as follows: total Fe—39.15, S—16.06 percent. Within this interval, the average total Fe contents of complete intersections range from 21.21 (Drillhole No. 25) to 49.18 percent (Drillhole No. 8), and the average S content from 9.40 (Drillhole No. 19) to 19.9 percent (Drillhole No. 17).

A representative head-sample of ore material from the Stackpool main ore zone, submitted to the Mines Branch, Ottawa, by Stackpool Mining Company Limited, gave the following analysis:

	PERCENT
Total Fe	36.8
Acid-soluble Fe	35.6
Bisulphate Fe	35.7
TiO_2	0.06
S	14.78
P	0.01
Mn	1.24
SiO_2	16.68
Insoluble	19.80

Photo by Eatons of Canada



Drill core of footwall acid breccia from Stockpool Mining Company Limited property, Genoa, and Marion townships, illustrating progressive chloritization and carbonatization of fresh rhyolite breccia (DDH 33, at 62 ft.) at left; through mildly altered breccia (DDH 46, at 838 ft.) at centre; to pseudo-conglomerate(DDH 33, at 245 ft.) at right (see further p. 10).

Photo by Eatons of Canada

Specimens of Woman River iron formation from Stockpool Mining Company Limited property, Genoa and Marion townships. At left, interbanded chert and siderite with central band of pyrrhotite (DDH 46 at 624 ft.); at centre, irregularly banded chert and siderite (DDH 46 at 603 ft.); and at right, interbanded pyrite and laminated argillite (DDH 46 at 157 ft.).

In terms of total Fe and S contents this head-sample corresponds fairly closely to the calculated average presented above. The small difference between total Fe and acid-soluble Fe in the sample demonstrates that only a small part of the total Fe is tied up in insoluble silicate minerals. The Mn content is significantly high. TiO_2 and P contents are low. However, the high SiO_2 and S contents and relatively low Fe content would preclude use of the material as a conventional furnace feed without some form of metallurgical treatment as considered below.

Concentration Tests

Results of Davis tube tests (Table IV), performed at the Mines Branch, Ottawa, on material from the main iron-bearing zone submitted by Stackpool Mining Company Limited, demonstrate the behaviour and type of concentrate to be expected from material of this type.

TABLE IV—RESULTS OF DAVIS TUBE TESTS CONDUCTED BY MINES BRANCH, OTTAWA, ON IRON-BEARING MATERIAL SUPPLIED BY STACKPOOL MINING CO. LTD.

(Data supplied by Stackpool Mining Co. Ltd.)

TEST NO. 1—SAMPLE GROUND 20 MINUTES TO 100 PERCENT −150 MESH
(All figures given in table are percent)

Product	Weight	Assay			Distribution		
		Soluble Iron	Sulphur	Insolubles	Soluble Iron	Sulphur	Insolubles
Concentrate	25.6	62.6	9.90	3.95	44.9	16.4	5.0
Tailing	74.4	26.4	17.4	25.9	55.1	83.6	95.0
Calculated Head	100.0	35.7	15.5	20.3	100.0	100.0	100.0

TEST NO. 2—SAMPLE GROUND 30 MINUTES TO 100 PERCENT −200 MESH
(All figures given in table are percent)

Product	Weight	Assay			Distribution		
		Soluble Iron	Sulphur	Insolubles	Soluble Iron	Sulphur	Insolubles
Concentrate	23.8	64.5	9.64	2.49	43.2	14.9	2.9
Tailing	76.2	26.4	17.2	26.0	56.8	85.1	97.1
Calculated Head	100.0	35.5	15.4	20.4	100.0	100.0	100.0

TEST NO. 3—SAMPLE GROUND 40 MINUTES TO 100 PERCENT −325 MESH
(All figures given in table are percent)

Product	Weight	Assay			Distribution		
		Soluble Iron	Sulphur	Insolubles	Soluble Iron	Sulphur	Insolubles
Concentrate	22.8	66.9	9.20	1.24	43.0	13.6	1.4
Tailing	77.2	26.2	17.2	25.7	57.0	86.4	98.6
Calculated Head	100.0	35.5	15.4	20.1	100.0	100.0	100.0

The results indicate that magnetic separation produces a high iron concentrate with low content of insoluble but significantly high sulphur content. The fineness of grind does not effectively lower the sulphur content. This undoubtedly reflects the intimate association of magnetite and sulphides in the ore material, particularly the distribution of tiny sulphide inclusions within individual magnetite grains. It thus appears that ore of this type would require some type of roasting process in order to reduce the sulphur content to conventional limits. On the other hand, the above concentrate would make a suitable addition to conventional sinter feed.

As indicated by the relative weight-percentages of concentrates and tails in the tests shown above, the weight-percent recovery of concentrate during any mining operations would be low. This factor, the high sulphur content of the concentrate, and the erratic distribution of the iron-bearing zone are formidable obstacles to successful exploitation of the deposits at present.

WEST PROPERTY

Location and Access

In 1960, Stackpool Mining Company Limited held 30 mining claims (S.108054–108079 and S.109206–109209) covering the iron range between Rush River and Woman River. The property is readily accessible by small aircraft landing on Woman River, at the west end of the claim group.

History

Most of the iron formation on the property is included in claims W.S.1, 2, and 3, originally staked by the C. K. Leith interests in 1906 and 1907 (*see* p. 46). The iron formation was explored at that time by limited trenching and sampling in connection with more extensive work on iron formation situated west of Woman River. Remains of old trenches are still visible.

A magnetometer survey, completed over some of the claims by Stackpool Mining Company Limited in 1958–59, outlined two magnetic anomalies over the iron formation; these were subsequently checked by 12 short diamond-drillholes.

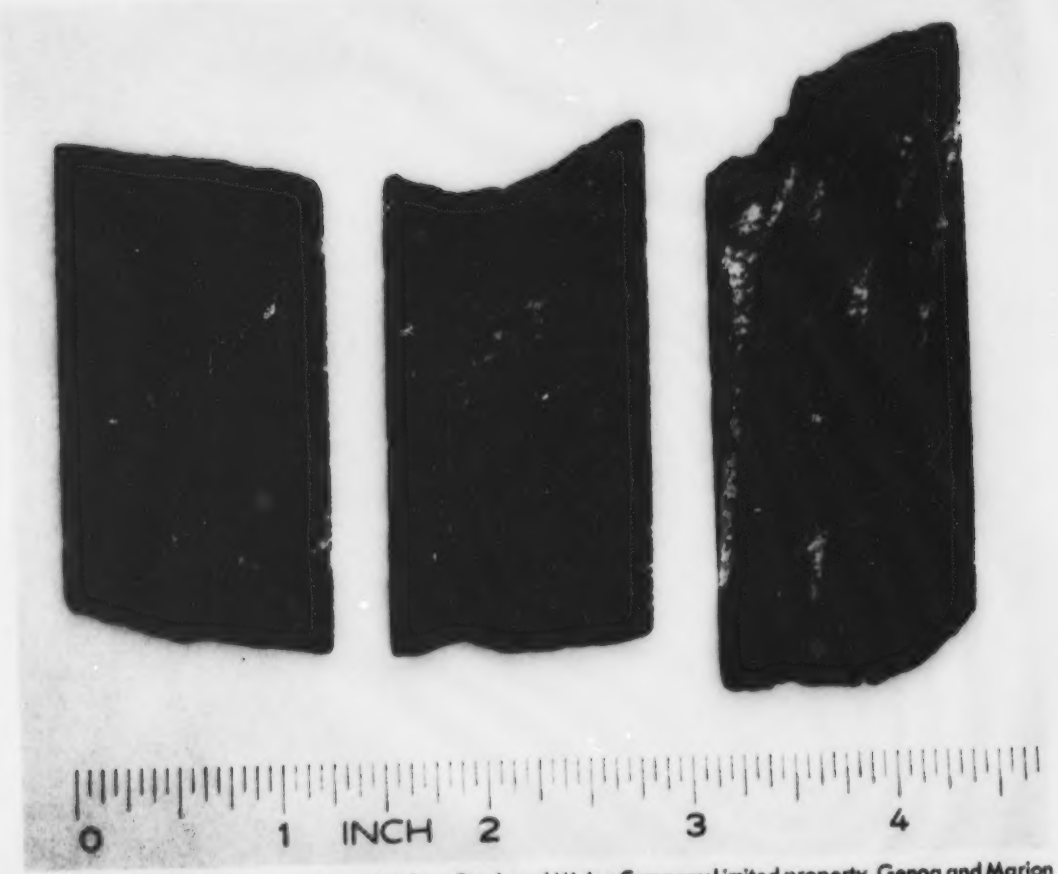
General Geology

In common with other portions of the iron range, the iron formation on these claims is located at the contact between underlying acid pyroclastic rocks to the south and overlying intermediate to basic flows to the north. A large granite porphyry stock is present in the younger, overlying volcanic rocks. Numerous porphyry sills and dikes cut the iron formation and volcanic rocks.

The underlying acid pyroclastic rocks are similar in most respects to those in other parts of the map-area. They consist for the most part of white to grey, felsitic breccia composed of angular fragments up to 6 inches in diameter, in a dense grey, felsitic matrix, as well as more massive rhyolite flows. A characteristic feature in this area is the presence of abundant, small, round quartz eyes both in the flows and in the pyroclastic rocks.

The iron formation is of the banded chert–jasper–siliceous magnetite type. There is no evidence of sulphide-carbonate zones such as are present in the iron formation east of Rush River. Several thin, lenticular bands of iron formation are present at the northeast corner of claim W.S.1; they thicken to the southwest, being 25–50 feet thick at the centre of the claim. To the west of a transverse fault near the south-central boundary of claim W.S.1, the iron formation thickens

Photo by Eatons of Canada



Specimens of Woman River iron formation from Stackpool Mining Company Limited property, Genoa and Marion townships. At left, dense, granular siderite with pyrrhotite - chalcopyrite - quartz veinlet (DDH 29 at 307 ft.); at centre, carbonaceous shale with concretionary pyrite and chert (DDH 26 at 442 ft.); and at right, interbanded carbonaceous shale, pyrrhotite and magnetite-bearing siderite (lower right) (DDH 34 at 326 ft.).

considerably to form a single continuous band 200–300 feet thick that crosses the northwest corner of claim W.S.2; it maintains this thickness for about 500 feet across the northeastern part of claim W.S.3; further west it gradually thins to 100–200 feet at the centre of the claim. In the west half of claim W.S.3, the iron formation is generally 50–150 feet thick; it has been considerably folded, faulted, and thereby segmented, in this vicinity.

For the most part the iron formation is extremely siliceous. Certain zones 10–20 feet thick contain considerable siliceous magnetite. Thin zones of magnetite-silicate-rich, shaly rock occur locally at the south or lower side of the iron formation. In addition, the iron formation contains a number of quartz porphyry sills; for example, in the centre of claim W.S.3, iron formation 800 feet thick includes nine separate porphyry layers each 5–55 feet thick.

Intermediate to basic, pillowed flows and associated dioritic rocks conformably overlie the banded iron formation.

A large, lenticular granite stock, a mile long and ¼ mile wide, lies parallel to the iron formation within the overlying volcanic rocks to the north (Fig. 3). This intrusive mass does not directly come in contact with the iron formation, at least not in surface outcrop. However, some of the porphyry sills present in the iron formation may be related to it.

Composition

The following assessment by the author is based upon information obtained by Stackpool Mining Company Limited during the 1957–58 exploration program.

The approximate horizontal width and grade of iron formation cut by nine of twelve diamond-drillholes (on claims S.108073, 108074, and 108069, all located in the northeast quarter of claim W.S.3), which together indicate the general nature of the iron bands in this area, are summarized in Table V.

TABLE V—APPROXIMATE WIDTHS AND GRADES OF IRON FORMATION; STACKPOOL MINING COMPANY LIMITED

(Table compiled by author from diamond-drill and assay data provided by Stackpool Mining Co. Ltd.)

Hole No.	Horizontal Width	Average Grade		
		Fe	S	Mn
	feet	percent	percent	percent
1	40	24.89	7.05	———
2	80	20.22	4.29	0.1
4	17	16.06	5.40	———
	10	13.40	2.13	———
	16	18.53	2.41	———
6	53	14.14	1.62	0.35
	60	21.18	2.92	0.66
7	70	13.57	2.64	0.44
8	100	14.78	1.58	———
9	55	12.39	1.73	———
10	33	13.57	1.74	———
11	140	15.82	3.65	———
Average	56	16.55	3.09	0.39

The low iron content and thin, discontinuous nature of the iron bands render them of no apparent value at present or in the foreseeable future.

Woman River Iron Property (C. K. Leith Estate)

LOCATION AND ACCESS

Claims W.S.1–12, inclusive, and S.V.528 and S.V.530, comprising 2,675 acres of contiguous land lying east and west of the Woman River, together form what is referred to here as the Woman River Iron Property, now held in the Estate of C. K. Leith. That part of the property east of Woman River, claims W.S.1–3, formerly held by Stackpool Mining Company Limited, has been described earlier in the report (p. 43) and is not considered further.

The property is best reached by light aircraft, which can land on Woman River. A trail and a surveyed baseline lead southwesterly along the iron range as far as claim W.S.9 near the southwest end of the range. An alternative route is by way of an old trail, now partly obscured by deadfalls and underbrush, west from a point on the Woman River ¼ mile north of its junction with Opeepeesway River.

HISTORY[1]

The earliest records date back to 1906–07, when the property was examined by Frank J. Katz and staked by a group including C. K. Leith and C. R. Van Hise of Madison, Wisconsin. This group, under field management of R. C. Allen with a crew of 26 men, constructed a permanent log camp on the west bank of the Woman River near its intersection with the south line of claim W.S.5.

A. T. Ward, of the firm of Speight and Van Nostrand, surveyors of Toronto, was employed 16–23 October 1907 in surveying power locations on three falls representing potential power sites on Woman River.

A total of 43 days work was devoted to exploration for iron ore, by means of dip-needle surveys and outcrop examination, in the area southeast of claims W.S.9 and 10 and west of Woman River and on lands north and northwest of claims W.S.10–12. A few small outliers of jasper were found southeast of claim W.S.9. No iron formation was found northwest of claims W.S.10–12.

During the 1907 season, 9344.2 linear feet of trenching and pitting was completed; the distribution on individual claims was as follows:

Claim	Feet
W.S.4	711
W.S.6	742
W.S.7	1555
W.S.8	5087.3
W.S.9	1248.9
Total	9344.2

The trenches were extensively sampled, and the samples were analysed for Fe, P, and S contents. These trenches were still discernible in 1961.

There is no record of further work on this part of the iron range.

GENERAL GEOLOGY

The banded iron formation on this property is found at the contact between underlying acid pyroclastic rocks, situated to the southeast (on claims W.S.4–9, inclusive, and to the northeast on claims W.S.10–12, inclusive, and S.V.528), and overlying intermediate to basic flow rocks. Porphyry sills and dikes and younger diabase dikes transect these rocks.

[1]From records supplied by Algoma Ore Properties Division of Algoma Steel Corporation Limited.

The acid pyroclastic rocks are essentially similar to those underlying the iron formation elsewhere on the range (pp. 4–10). White to pink rhyolite breccia predominates. Trachytic breccia is common. Fragments in the breccia are up to 10 inches in diameter but are generally less than 5 inches. More massive felsitic phases are commonly porphyritic.

The distribution and thickness of iron formation is shown in Figure 3 and summarized elsewhere in this report (pp. 14–15). The iron formation attains a maximum thickness of 1,400 feet on claim W.S.8, but is generally less than 500 feet thick.

The iron formation is of composite character, as previously described (pp. 22–25). As noted by J. Katz in 1906, the prominent feature of all "belts" is the great variation in character both along and across strike. The iron formation on claim W.S.7 and to the east is noticeably less ferruginous than that to the southwest. In any stratigraphic section across the iron formation, the iron content generally increases towards the stratigraphic base, where it directly overlies acid pyroclastic rocks. The most iron-rich parts are present on claims W.S.8–12 inclusive.

Andesitic to basaltic flows containing well-developed pillow structures conformably overlie the banded iron formation. Coarse-grained dioritic phases, as well as granitic sills and dikes, are locally present.

IRON-BEARING ZONES

The exploration work of 1906–07 uncovered iron-bearing zones near the east side of claims W.S.11 and 12 and on claim W.S.8, on the crest and east slope of the high iron ridge. The zones are referred to as No. 1 and No. 2 zones, respectively, No. 1 zone lying southwest of No. 2 zone. The following descriptions are taken largely from records of the 1906–07 exploration provided by Algoma Ore Properties Division of The Algoma Steel Corporation Limited.

No. 1 Zone (Claims W.S.11 and 12)

Near the east side of claims W.S.11 and 12, and extending about 200 feet into each claim, is a zone about 60 feet wide and 700 feet long at the northeast margin of the iron formation. This zone is bordered on the southwest by cherty iron formation, and on the northeast by low ground that is presumably underlain by acid volcanic rocks. The iron-bearing zone itself is composed of assorted banded chert, jasper, siliceous magnetite, and hematite. The relative proportions of magnetite and hematite vary from place to place. There is no evidence of any high-grade or direct-shipping ore in this zone.

Samples of higher-grade material from trenches in this zone gave results as shown in Table VI.

TABLE VI—ANALYSES OF HIGHER-GRADE MATERIAL, NO. 1 ZONE

(Chemical data obtained during 1906–07 program. Data supplied by Algoma Ore Properties Division of the Algoma Steel Corp. Ltd.)

	Sample No.			
	1	2	3	4
	percent	percent	percent	percent
Fe	43.19	31.92	37.59	17.85
P	0.016	0.012	0.006	0.01
S			0.174	0.199

Heenan, Marion, and Part of Genoa Townships

The following table (Table VII) records the results of various analyses of material obtained from the No. 1 zone during the early exploration. Trench No. 2 is located at the north edge of the zone and trench No. 5 at the south edge. The location of trench No. 4 is not known.

TABLE VII—ANALYSES OF IRON-BEARING MATERIAL, NO. 1 ZONE

(Data supplied by Algoma Ore Properties Division of The Algoma Steel Corp. Ltd.)

Sample No.	Remarks	Fe	P	S	Sampled by
		percent	percent	percent	
WR.4	Soft, dark-red and black hematite	43.19	0.016	——	Katz, 1906
C.2	Average sample ore and chert, Katz trench No. 2	17.85	0.01	0.199	Katz, 1906
WR.2	Surface wad-like material, Katz trench No. 2	11.16	0.016	——	Katz, 1906
B.2	Surface wad-like material	20.86	0.022	3.94	Allen and McCulloch, 1907
WR.3	Average sample jasper and bands, blue hematite	14.54	0.025	——	Katz, 1906
D.2	Bands, blue hematite	37.71	0.013	0.474	Katz, 1906
WR.6	Hematite seams and jasper.	54.35	0.01	——	Katz, 1906
WR.7	Hematite seams and jasper.	56.23	0.022	——	Katz, 1906
E.3	Hematite seams and jasper.	55.27	0.006	0.407	Allen and McCulloch, 1907
WR.8	Cherty magnetite, trench No. 4	37.73	0.013	——	Katz, 1906
WR.9	Cherty magnetite, trench No. 4	28.86	0.032	——	Katz, 1906
WR.10	Cherty magnetite, trench No. 4	34.88	0.033	——	Katz, 1906
WR.11	Cherty magnetite, trench No. 4	19.40	0.088	——	Katz, 1906
F.4	Cherty magnetite, trench No. 4	31.04	0.039	0.137	Allen and McCulloch, 1907
WR.12	Soft banded hematite mixed with chert and jasper, trench No. 5	31.92	0.012	——	Katz, 1906
A.1	Soft banded hematite mixed with chert and jasper, trench No. 5	37.59	0.006	0.174	Allen and McCulloch, 1907
Average		33.28	0.018	0.897	

In summary, available information indicates that zone No. 1 is 30–60 feet wide and 300–700 feet long. It is composed of chert, siliceous magnetite, and hematite. This material locally contains up to 56 percent Fe. However, the average composition is indicated to be approximately as follows: Fe—30; P—0.018; S—0.9 percent.

Zone No. 2 (Claim W.S.8)

Iron-rich material forms part of the crest and southeast slope of the high ridge on claim W.S.8. This zone as here defined is about 400 feet wide and 1,500 feet long. It is composed of assorted banded chert, jasper, and siliceous magnetite, together with minor siderite and pyrite. According to R. C. Allen, who supervised the original exploration, about one-third of this zone may be expected to be composed of material averaging about 40 percent Fe. All of the higher-grade material is mixed with various proportions of chert and jasper.

Photomicrograph of magnetite-bearing phase of Woman River Iron Property, Hearnan township. Grey, magnetite; white, pyrite; remainder, silica. (X 264)

Table VIII records the results of various analyses of ore from No. 2 zone made in 1906–07. Trench locations are unknown.

TABLE VIII—ANALYSES OF IRON-BEARING MATERIAL FROM NO. 2 ZONE

(Chemical data obtained during 1906–07 program. Data supplied by Algoma Ore Properties Division of the Algoma Steel Corp. Ltd.)

Sample No.	Remarks	Fe	P	S	Sampled by
		percent	percent	percent	
WR.16	Average sample of bottom trench	28.26	0.028	——	Katz, 1906
WR.16 (No. 2)	North end of ore belt	29.35	0.02	1.426	Allen & McCulloch
M.26	Trench No. 30	14.10	——	——	Allen & McCulloch
M.28	Trench No. 30	——	——	——	Allen & McCulloch
M.29	Trench No. 30	17.90	0.008	0.12	Allen & McCulloch
M.30	Trench No. 30	9.75	——	——	Allen & McCulloch
M.24	Trench No. 31	16.55	0.02	0.046	Allen & McCulloch
M.27	Trench No. 29	21.41	——	——	Allen & McCulloch
M.5	Trench No. 29	35.18	——	——	Allen & McCulloch
M.4	Trench No. 29	29.35	——	——	Allen & McCulloch
M.3	Trench No. 29	26.83	0.007	1.041	Allen & McCulloch
M.1	Trench No. 29	42.79	——	——	Allen & McCulloch
M.12	Trench No. 13	31.41	——	——	Allen & McCulloch
M.13	Trench No. 13	35.62	——	——	Allen & McCulloch
M.14	Trench No. 13	41.27	——	——	Allen & McCulloch
M.15	Trench No. 13	32.50	0.014	2.88	Allen & McCulloch
M.18	Trench No. 28	11.62	0.005	0.672	Allen & McCulloch
M.19	Trench No. 27	37.20	——	——	Allen & McCulloch
M.21	Trench No. 27	15.60	——	——	Allen & McCulloch
M.8	Trench No. 32	43.28	0.007	3.239	Allen & McCulloch
M.9	Trench No. 32	40.85	——	——	Allen & McCulloch
M.10	Trench No. 32	41.19	——	——	Allen & McCulloch
M.46	Trench No. 33	12.92	——	——	Allen & McCulloch
M.47	Trench No. 33	14.70	——	——	Allen & McCulloch
M.49	Trench No. 33	32.95	——	——	Allen & McCulloch
M.48	Trench No. 33	10.15	——	——	Allen & McCulloch
M.52	Trench No. 33	29.97	——	——	Allen & McCulloch
M.61	Trench No. 33	24.65	——	——	Allen & McCulloch
M.62	Trench No. 33	19.	0.006	0.059	Allen & McCulloch
M.81	Trench No. 34	25.06	——	——	Allen & McCulloch
M.80–84	Trench No. 34	37.93	——	——	Allen & McCulloch
M.77–79	Trench No. 34	23.94	——	——	Allen & McCulloch
M.67	Trench No. 34	14.22	——	——	Allen & McCulloch
Average		26.34	0.0127	1.184	

In summary, No. 2 zone is indicated to be approximately 400 feet wide and 1,500 feet long. It is underlain by material that locally is up to 43 percent Fe but averages about 26.3 percent Fe; 0.013 percent P; and 1.18 percent S.

Concentration Tests

Five grab-samples of iron-bearing material were taken by the author across the No. 2 ore zone during the 1961 field season in order to test its amenability to conventional magnetic separation methods. No. 4 sample is of low-grade material, whereas the other four samples are of higher-grade material.

The five grab-samples were taken along a line at right-angles on the south side of the Main Baseline (1961) at Station 224. This station is situated on claim W.S.8, on the Main Baseline at a point in line with the west side of claim

W.S.7; this is near the crest of the large iron ridge. The five samples are located at the following distances from the Main Baseline:

Sample No.	Distance from Station 224 (Main Baseline 1961) feet
3	150
2	250
5	350
4	400
1	540

The five samples were tested during 1961 in the laboratory of the Ontario Research Foundation, Toronto, in co-operation with the Laboratory Branch of the Ontario Department of Mines, for magnetic separatability in a Davis tube; the results are shown in Table IX.

The chemical analysis of head-samples demonstrates that most of the iron is present in soluble form, only a small portion being tied up in non-recoverable silicate form. However, the relatively low total Fe recovery by Davis tube demonstrates that a substantial amount of the iron is present in non-magnetic forms (siderite, pyrite, hematite, etc.), which would not be recovered by conventional magnetic separation methods. This would mean a high proportion of waste to concentrate under conventional operating conditions.

The concentrates, in terms of Fe and SiO_2 contents, are of marginal-grade only, with the exception of those from sample No. 1. The similarity in Fe content of the −100-mesh concentrates and the −200-mesh concentrates is noteworthy; this indicates that the finer grinding does not effect a substantial improvement in liberating individual magnetite grains. Whether or not further grinding, say to −325-mesh, would materially improve the concentrate has not been determined.

In summary, the limited size of the iron-bearing zone, and the fine grain-size and complex mineralogy leading to low iron recovery and marginal-grade concentrates by conventional magnetic techniques, render it of limited value at present.

Thus, the two potential ore zones on the Woman River property of the C. K. Leith Estate, as at present defined, are not attractive under existing conditions. However, the property has so far been prospected in a preliminary way only; it has never been drilled, to the author's knowledge. Further exploration along the stratigraphic base of the iron formation, including diamond-drilling, together with metallurgical investigations, may yet reveal a significant ore zone.

LEAD–ZINC

Lead-zinc mineralization is present in banded iron formation at the northeast end of the range, mainly on claim W.D.717, Genoa township. The following description is taken largely from Moore (1927, pp. 94, 95), who examined the prospect shortly after it had been worked. Streaks of sphalerite and galena were first found while drilling the iron formation on claim W.D.717. This led to the discovery of a mineralized outcrop in a trench nearby. A test pit was sunk to a depth of 8 feet on this outcrop, at which depth a vein of almost solid galena,

TABLE IX—RESULTS OF MAGNETIC CONCENTRATION TESTS ON MATERIAL FROM NO. 2 IRON-BEARING ZONE, WOMAN RIVER IRON FORMATION

PROPERTY, C. K. LEITH ESTATE, HEENAN TOWNSHIP

ANALYTICAL RESULTS

Sample No.[1]	Distance from Main Baseline (1961)	Chemical Analysis of Head Samples		Screen Analysis of −100 mesh Samples			
				200 mesh		325 mesh	
		Total Iron	Soluble Iron[2]	Retained	Passed	Retained	Passed
	feet	percent	percent	percent	percent	percent	percent
3	150	42.45	34.45	6.35	93.65	81.38	9.87
2	250	40.18	38.22	14.32	85.68	40.94	41.22
5	350	40.45	36.38	19.16	80.84	14.88	61.18
4	400	25.95	25.25	6.59	93.41	10.77	81.93
1	540	45.20	45.20	17.04	82.96	4.72	77.30

DAVIS TUBE TESTS

Sample No.[1]	Distance from Main Baseline (1961)	−100 mesh			−200 mesh						
		Recovery Weight	Recovery	Soluble Iron in Magnetics	Recovery Weight	Recovery	Soluble Iron in Magnetics	SiO_2 in Magnetics	Phosphorus in Magnetics	Sulphur in Magnetics	TiO_2 in Magnetics
	feet	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent
3	150	13.0	43.33	57.71	12.71	42.36	59.20	10.15	0.0	0.04	less than 0.10
2	250	14.8	49.45	59.97	14.62	48.70	60.82	11.47	none	0.01	less than 0.10
5	350	16.4	54.66	54.00	15.87	52.90	57.66	13.50	trace	0.23	less than 0.10
4	400	8.54	28.45	64.95	8.36	27.87	63.61	6.34	0.004	0.23	less than 0.10
1	540	21.2	70.33	62.67	19.84	66.10	66.31	5.61	0.004	0.08	less than 0.10

Sample No.[1]	Distance from Main Baseline (1961)	−100 mesh				−200 mesh			
		Iron Units in Sample	Iron Units in Concentrate	Total Iron Recovery by Davis Tube	Grade of Concentrate	Iron Units in Sample	Iron Units in Concentrate	Total Iron Recovery by Davis Tube	Grade of Concentrate
	feet			percent	percent			percent	percent
3	150	35.45	25.0	70.5	57.71	35.45	25.1	70.9	59.20
2	250	38.22	29.6	77.4	59.97	38.22	29.6	77.4	60.82
5	350	36.38	29.55	81.2	54.00	36.38	30.4	83.8	57.66
4	400	25.25	18.5	73.2	64.95	25.25	17.7	70.1	63.61
1	540	45.20	44.1	97.5	62.67	45.20	43.7	96.8	66.31

Tests conducted by Ontario Research Foundation in co-operation with Laboratory Branch, Ontario Department of Mines, 1961, on material supplied by the author.

[1]For location of samples see table on page 71.

[2]Soluble in warm hydrochloric acid; this is commonly taken as "recoverable" iron.

assaying 73.44 percent lead and 6.01 percent zinc, was found. The vein at the surface was 18 inches wide at the east side of the shaft and 6 inches wide at the west side. In the bottom of the shaft, the vein is 36 inches wide at the east side. Fifty feet east of the shaft there is an irregular band of sphalerite, galena, and chalcopyrite in the iron formation, and another irregular band of stringers, 25 feet north of this point, in the same formation. This occurrence is described in greater detail in another paper by Moore (1926, p. 371). Despite considerable work done at that time, no continuity could be established to the vein.

Since the time of Moore's examination of the area, the iron formation in the vicinity of the lead-zinc mineralization has been prospected and drilled in considerable detail. However, no mineralization has been revealed to match the discovery outcrop in content of valuable metals.

In 1950, Central Sudbury Lead-Zinc Mines Limited completed 5,000 feet of diamond-drilling over 23 holes. The holes were drilled in the general vicinity of the original high-grade discovery, on which a test pit had been previously sunk on claim W.D.717, Genoa township.

The more important results taken from a prospectus filed with the Ontario Securities Commission by Central Sudbury Lead-Zinc Mines Limited, dated 2 June 1952, are listed in Table X.

TABLE X—DRILLING RESULTS, CENTRAL SUDBURY LEAD-ZINC MINES LIMITED

(Data taken from Prospectus filed with Ontario Securities Commission by Central Sudbury Lead-Zinc Mines Ltd., 2 June 1952.)

Hole	Location	Intersection		Core Length	Average Assay	
		From	To		Pb	Zn
		feet	feet	feet	percent	percent
CS. 1	125 ft. S. of test pit	——	——	——	No values	
CS. 2	50 ft. N. 70°E. of CS.1	——	——	——	No values	
CS. 3	50 ft. S. 70°W. of CS.1	207.5	225	17.5	4.97	3.27
CS. 4	50 ft. S. 70°W. of CS.2	254.5	275.0	2.5	5.53	5.25
CS. 5	50 ft. S. 70°W. of CS.3	——	——	——	No values	
CS. 6	275 ft. S. 70°W. of test pit	165.0	207.0	42.0	1.44	3.51
CS.15	105 ft. S. of CS.6	287.5	322.5	35.0	3.97	7.58
CS. 7	50 ft. W. of CS.6	147.5	162.5	15.0	1.64	2.79
CS.13	100 ft. S. of CS.7	277.5	282.5	5.0	4.06	2.28
CS.13		333.0	340.0	7.0	0.53	1.94
CS.11	50 ft. W. of CS.7	113.5	120.0	6.5	1.62	2.32
CS.14		167.0	172.5	5.5	0.58	1.66
CS.14	100 ft. S. of CS.11	240.0	252.5	12.5	0.68	2.31
CS.14		291.2	200.0	8.8	5.60	12.56
CS.12	50 ft. W. of CS.11	——	——	——	No values	
CS. 8	24 ft. S. 40°E. of CS.2	175.0	180.0	5.0	1.78	2.32
CS. 8		195.0	200.0	5.0	0.24	3.76
CS. 9	50 ft. E. of CS.8	——	——	——	No values	
CS.10	50 ft. E. of CS.9	——	——	——	No values	
CS.16	Slightly E. of CS.1	150	170	20	1.31	3.82
CS.17	Very close to CS.3	160	165	5.0	0.50	1.39
CS.18	Slightly E. of CS.15	145	160	15	1.40	2.78
CS.19	Between CS.17 and CS.4	275	280	5.0	1.26	3.32
		270	285	15.0	0.75	1.94
CS.21	Near CS.14	312	320	8.0	2.13	5.80
CS.22	Near CS.15	300	315	15.0	0.75	1.90
CS.23	About 100 ft. W. of CS.12	No lead-zinc mineralization.				

Of the 50 holes drilled in 1957 and 1958 by Stackpool Mining Company Limited lead-zinc-copper mineralization was noted by the author in the core of nine holes as given in Table XI.

TABLE XI—LEAD-ZINC MINERALIZATION IN NINE HOLES DRILLED BY STACKPOOL MINING COMPANY LIMITED IN 1957 AND 1958

(Based on study of diamond-drill core by the author in 1961)

Hole	Footage	Mineralization	Host Rock
5	35–46	Zn–Cu	footwall acid pyroclastics
21	235–244	Pb	footwall acid pyroclastics
25	76–84	Zn	sulphide-carbonate iron formation
26	250–255.5	Zn–Pb	sulphide-carbonate iron formation
27	242–252.5	Zn–Pb	sulphide-carbonate iron formation
27	300–327	Cu	sulphide-carbonate iron formation
27	327–336	Zn–Pb	sulphide-carbonate iron formation
37	205.5–213	Zn–Pb	banded cherty iron formation
37	224	Zn–Pb	banded cherty iron formation
37	283–285	Zn–Pb	middle volcanic zone
37	313; 314.5–320	Zn–Pb	middle volcanic zone
37	412–414	Zn–Pb	middle volcanic zone
39	185	Cu	banded cherty iron formation
41	331	Zn	banded cherty iron formation
41	365–375	Zn–Cu	banded cherty iron formation
41	376	Zn–Cu	banded cherty iron formation
42	374.5	Cu	banded cherty iron formation
42	424	Zn	banded cherty iron formation
42	449.5–450	Zn	banded cherty iron formation

With two exceptions, the mineralization consists of very thin seams, specks, and stringers of metal-bearing sulphides, generally associated with quartz and calcite. According to records provided by Stackpool Mining Company Limited, in Drillhole No. 5 an 11-foot core-section assayed 1.55 percent Cu, 3.30 percent Zn, and 0.44 ounces Au per ton; and in Drillhole No. 27, a 10.5-foot section assayed 11.98 percent Zn.

Thus, the mineralized zone has been drilled in considerable detail. Although spotty mineralization is widespread, the work to date has failed to locate a significant metal concentration. It would seem that sufficient work has been completed in the immediate vicinity of the original discovery to make it unlikely that such a concentration is present to the depth drilled to date.

GOLD

Fummerton Mining and Development Company Limited

In 1946 this company held 16 unpatented claims in the southeast corner of Heenan township as follows: claims S.39903–14, S.39372–74, S.34369–71, and S.34203. The claim group covers the iron formation and adjacent volcanic rocks in the area extending for about 8,000 feet from the west end of Claim Lake.

Two small syenite occurrences at the centre of claim W.S.8 are reported to contain gold. Geological and magnetic surveys were conducted in 1946 in order to outline the iron bands and possible favourable structures. There is no record of further work on the property.

Wendmar Gold Mines Limited

In 1946, Wendmar Gold Mines Limited held the following 18 unpatented claims: S.39300–09 and S.39292–99, in the centre of Marion township. The claim group is bisected by Rush River, which, at a point about ½ mile north of the north boundary of the claim group, flows into Woman River. The east boundary of the group lies 1,200 feet west of the west boundary of claim W.D.1734 (Fig. 3).

The claim group covers several thin, cherty bands of iron formation and enclosing volcanic rocks. Some carbonatization and pyrite mineralization were reportedly observed in acid pyroclastic rocks south of the iron formation on claim S.39301. Geological and magnetic surveys were conducted in 1946 to test for favourable structures. There is no record of further work.

Other Occurrences

CLAIM W.S.1, MARION TOWNSHIP

Evidence of diamond-drilling is found a mile east of Woman River, on the west half of claim W.S.1, Marion township. Several old drill sites and scattered piles of drill core are present. All the drilling appears to have been done in the granite porphyry stock (Fig. 3), presumably to investigate the significance of disseminated pyrite in the granite. No record of this work has been found.

RUSH RIVER, MARION TOWNSHIP

During the 1961 field-season, a west-northwest-trending, vertical shear zone in schistose diorite, containing disseminated pyrite over a width of 6–10 feet, was observed at a point on the east shore of Rush River, about 3,000 feet north of Rush Lake, Marion township. A grab-sample taken from this zone showed traces of gold, copper, lead, and nickel. Significant concentrations of metal may be present in this shear zone or in similar zones nearby.

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